This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

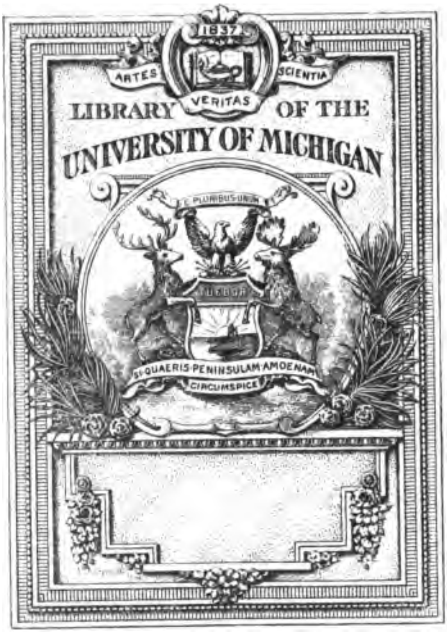
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

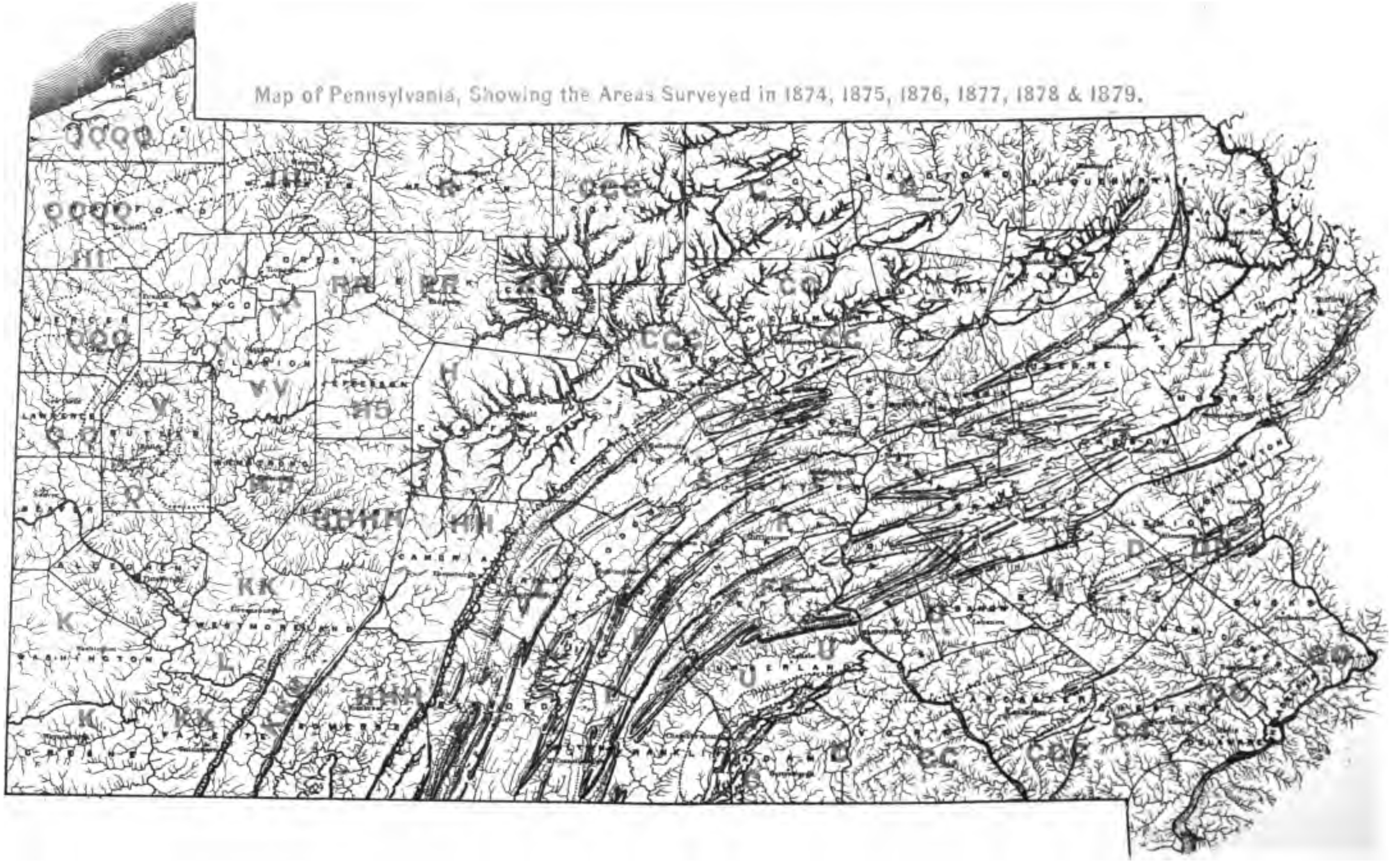
B 1,069,941


1837
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE

QE
157
.A233

1837
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE

QE
157
.A233



Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876, 1877, 1878 & 1879.

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:
REPORT OF PROGRESS IN 1879.

VV.

47102

THE GEOLOGY OF
CLARION COUNTY.

BY

H. MARTYN CHANCE.

WITH
A COLORED GEOLOGICAL MAP OF CLARION COUNTY,
A MAP OF THE ANTICLINALS, AND OIL-BELT,
A CONTOURED MAP OF THE OLD RIVER CHANNEL AT PARKER,
FOUR PAGE PLATES,
AND 83 LOCAL SECTIONS FIGURED IN THE TEXT.

HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY.
1880.

Entered, for the Commonwealth of Pennsylvania, in the year 1880, according
to acts of Congress,
By WILLIAM A. INGHAM,
Secretary of the Board of Commissioners of Geological Survey,
In the office of the Librarian of Congress, at
WASHINGTON, D. C.

Electrotyped and printed by
LANE S. HART, State Printer,
Harrisburg, Pa.

BOARD OF COMMISSIONERS.

His Excellency, HENRY M. HOYT, *Governor*,
and *ex-officio* President of the Board, Harrisburg.

Ario Pardee,	Hazleton.
William A. Ingham,	Philadelphia.
Henry S. Eckert,	Reading.
Henry McCormick,	Harrisburg.
James Macfarlane,	Towanda.
John B. Pearse,	Philadelphia.
Joseph Willcox,	Philadelphia.
Hon. Daniel J. Morrell,	Johnstown.
Henry W. Oliver,	Pittsburgh.
Samuel Q. Brown,	Pleasantville.

SECRETARY OF THE BOARD.

William A. Ingham,	Philadelphia.

STATE GEOLOGIST.

Peter Lesley,	Philadelphia.

1880.

ASSISTANT GEOLOGISTS.

PERSIFOR FRAZER, Jr.—Geologist in charge of the Survey of Adams, York, Lancaster and Chester counties.

AMBROSE E. LEHMAN—Topographical Assistant, for mapping the South Mountain.

FREDERICK PRIME, Jr.—Geologist in charge of the Survey of Northampton, Lehigh, and Berks counties.

E. V. D'INVILLIERS—Topographical Assistant, for mapping the Easton-Reading range.

FRANKLIN PLATT—Geologist in charge of the Survey of the coal fields of Tioga, Bradford, Potter, Lycoming, and Sullivan counties.

W. G. PLATT—Geologist in charge of the Survey of Armstrong and Jefferson counties.

R. H. SANDERS—Topographical Assistant in Dauphin, Lebanon and Berks counties.

I. C. WHITE—Geologist in charge of the Survey of Crawford and Erie counties.

J. F. CARLL—Geologist in charge of the Survey of the Oil Regions.

H. M. CHANCE—Geologist in charge of the Survey of Clinton and Clarion counties.

C. A. ASHBURNER—Geologist in charge of the Survey of McKean, Elk, Cameron and Forest counties.

A. W. SHEAFER—Assistant in McKean county, &c.

F. A. GENTH—Mineralogist and Chemist at Philadelphia.

F. A. GENTH, Jr—Aid in the Laboratory.

A. S. McCREATH— Chemist, in charge of the Laboratory of the Survey, 223 Market street, Harrisburg.

JOHN M. STINSON—Aid in the Laboratory.

C. E. HALL— Geologist in charge of the Survey of Delaware county, and Palæontologist in charge of the Museum.

N. A. STOCKTON—Aid in the Museum.

M. G. CARRAHER—Aid in the Museum.

CHARLES ALLEN—Assistant in locating outcrops in Delaware county, and for Records of Railroad and other Levels, Harrisburg.

H. C. LEWIS—Volunteer geologist for the survey of the gravel deposits of south-eastern Pennsylvania.

LEO LESQUEREUX—Fossil Botanist, Columbus, Ohio.

E. B. HARDEN—Topographer in charge of Office Work, &c. 1008 Clinton street, Philadelphia.

O. B. HARDEN—Assistant in preparing illustrations.

F. W. FORMAN—Clerk in charge of the Publications of the Survey, 223 Market street, Harrisburg.

PHILADELPHIA, *March 30, 1880.*

To his Excellency Governor HENRY M. HOYT, *Chairman of the Board of Commissioners of the Second Geological Survey of Pennsylvania:*

SIR: I have great pleasure in transmitting the excellent report of Mr. H. Martyn Chance, on the geology of Clarion county.

This is virtually a continuation towards the east of his survey of Northern Butler recently published by the Board; as that was a continuation northeastward of his previous surveys along the Beaver river and Slippery Rock creek.

It is well to state, that the continuous surveys of Prof. White in Greene*, Washington*, Allegheny, Beaver, Southern Butler, Lawrence, Mercer, Crawford and Erie,—of Mr. Chance in Beaver, Lawrence, Northern Butler, Venango†, Clarion and Forest†;—of Mr. Carll in Mercer, Crawford, Warren, Venango, McKean, Clarion, Forest, Armstrong and Butler, along the oil belts, and across the line into New York;—of Mr. W. G. Platt in Armstrong, Southern Jefferson, Indiana, Cambria‡ and Somerset‡;—of Mr. Franklin Platt in Jefferson and Clearfield;—and of Mr. Ashburner in Forest, Elk, Cameron and McKean—overlapping each other, as these surveys have done, and executed, as they have been, by these geologists, concurrently in complete harmony of sentiment, and in familiar intercourse with one another, they establish on the soundest basis the whole geology of western Pennsylvania.

Disciplined by five years of uninterrupted field and office-work, in surveying the Coal measures and underlying formations, over an immense area, with a zeal which never flagged, and on methods approved by varied experience, slowly and carefully applied, and richly illustrated by maps and measured sections, aided by thousands of deep borings—these gentlemen have deserved well of the Commonwealth, and the fruits of their arduous labors (more arduous than can ever be appreciated) will remain as a legacy from the Legislature to successive generations of the citizens of Pennsylvania.

---

* While assisting Prof. Stevenson.

† While assisting Mr. Carll.

‡ While assisting Mr. Franklin Platt.

Reports of all of the above named surveys have now been published except those of Armstrong; Erie and Crawford; Warren and Venango; Forest, Elk and Cameron; and McKean; and the manuscripts of these reports are nearly ready for the press.

As the reports of Tioga and Bradford have been published, and those of Potter, Lycoming and Sullivan are printed and ready for binding; as Mr. Chance's report on Clinton will be ready to go to press in May; and as most of Centre and all of Blair* has been surveyed,—there only remains a close revision for a second report of the geology of Jefferson and Clearfield counties† to complete *the strictly geological description of the Bituminous coal fields of Pennsylvania;* that is, of all Western Pennsylvania, and of Northern Pennsylvania as far east as the North Branch of the Susquehanna.

Meantime the final report of Mr. Carll on the geology of the Oil region is going through the press, and an additional volume of oil-well records is preparing.

As a large part of the force of the survey must be applied this year to the second survey of the Anthracite region, and as the mapping of the South Mountains north of Gettysburg, and east of Reading must be carried forward, as well as the survey of Chester and Berks counties, it may become necessary to postpone to 1881 the surveys of Fulton, Bedford, the Franklin county valley, the Broad top and other portions of Huntingdon, Union and Snyder, Northumberland, Montour, Susquehanna, Wayne and Pike, and such portions of Luzerne, Lackawanna, Monroe, and other counties as lie outside the Anthracite coal fields—subject to the decision of the Board.

---

*The report of this county is nearly ready for the press; its coal was reported with Cambria county.

†This will be in the coming season of 1880 by Mr. W. G. Platt, who has already revised Southern Jefferson.

I remain, sir,
With great respect,
Your obedient servant,
'J. P. LESLEY.

907 Walnut Street,
Philadelphia, *January 20, 1880.*

Prof. J. P. Lesley, *State Geologist:*

Dear Sir: In submitting this report on the geology of Clarion county, surveyed in 1879, I invite your attention to the map and description of the very curious and interesting ancient water channel at Parker, included in Chapter Second.

If I have not misinterpreted the topographical and geological features of the locality it seems certain that the Allegheny river valley, and its tributary gorges, have been deepened at least 250 feet *since the Glacial period;* that this erosion could not have been effected by the northern glacier, or a prong of the same; and that a long period of time must be assigned to the operation through the agency of river water.

At an assumed rate of one tenth of an inch per annum (for the whole valley section) the erosion would demand 30,000 years; at an assumed rate of one fiftieth of an inch per annum, 150,000 years.

An additional period of time, for the calculation of which we have no data, was occupied by the refilling of the present river valley with the 50 feet of detrital matter over which the river now flows.

As Prof. Joseph LeConte has so clearly shown, in a recent article in the American Journal of Science and Art, both the rate of excavation and the rate of refilling depended on the amount of scouring matter held in suspension by the flood.

Both excavation and refilling are parts of one process. When river water is *underloaded* with suspended sand, it excavates; when *overloaded,* it deposits part of its load and refills its channel. The latter part of the process must always be more rapid than the former.

But, the greater the quantity of water passing down a valley the less will be its *relative* load of suspended cutting material, and the slower must be the rate of erosion. Consequently, the doctrine of a "pluvial era" fails just here to explain what its advocates wish it to explain; for the maximum of erosion is reached, not when the maximum of flood descends the channel, but when the flood carries forward all it can hold in suspension without dropping any.

In the case of the Allegheny river valley this maximum may have been reached more than once since the retreat of the ice. That the water was overloaded at first may be taken for granted. When the equilibrium of maximum erosion was established, the valley-cutting began, and continued (at accellerated rate) to the depth of the old valley bed of the Clarion. Then followed a time of *overloaded* flood, and refilling of that old valley. A subsequent decline in the quantity of suspended matter permitted erosion to be recommenced, and continued (with accelerating rate) until the present Allegheny valley *rock* bed was reached. Then followed a time of *overloaded* flood, and the 50 feet of detritus was deposited, over the surface of which the present Allegheny river flows.

My thanks are due to the citizens of Clarion county for courtesies during the survey, and for valuable information: to Mr. Benjamin Newton C. E. of Foxburg; Captain Brinker of Fairmount; Major W. C. Mobley of Parker; Mr. William L. Fox of Foxburg; Dr. Towler and Colonel Hunt of Marienville; Mr. John Haggerty M. E. of Brady's Bend; B. J. Reid, Esq. of Clarion; Colonel Lyons of Sligo; and others.

I remain, dear sir,
Very respectfully,
Your obedient servant,
H. MARTYN CHANCE.

TABLE OF CONTENTS.

Page.

Letter of transmittal, ... v

Chapter 1. Introduction, ... 1
  Boundaries, ... 1
  Area, ... 2
  Population, ... 2
  Railroads, ... 4
  Soil, ... 5
  Timber, ... 6
  Surface Rocks, ... 6
  Ores, ... 8

Chapter 2. Topography and Drainage, ... 9
  Railroad Elevations, ... 10
  Oil Well Elevations, ... 13
  Drainage, ... 16
  Parker Ancient Channel, ... 17
  Callensburg Old Channel, ... 20
  Glacial Drift, ... 21

Chapter 3. Anticlinals and synclinals, ... 23
  Brookville (?) anticlinal, ... 25
  Fairmount synclinal, ... 25
  Anthony's Bend anticlinal, ... 26
  Centreville synclinal, ... 26
  Kellersburg anticlinal, ... 26
  Lawsonham synclinal, ... 27
  Brady's Bend anticlinal, ... 27
  Brady's Bend synclinal, ... 28
  Millerstown anticlinal, ... 29
  Millerstown synclinal, ... 29

Chapter 4. Lower Productive Coal measures, ... 31
  Freeport group, ... 33
  Kittanning group, ... 41
  Clarion group, ... 49

Page.
Chapter 5. Rocks underlying the coal measures, . . . 57
Pocono, No. X, ... 57
Mauch Chunk Red Shale, No. XI, ... 58
Conglomerate series, No. XII, ... 59
Chapter 6. Detailed Geology south of the Clarion river, 65
Brady township, ... 66
Madison township, ... 68
Toby township, ... 78
Porter township, ... 87
Red Bank township, ... 97
Perry township, ... 117
Licking township, ... 125
Piney township, ... 127
Monroe township, ... 135
Limestone township, ... 137
Clarion township, ... 140
Mill Creek township, ... 146
Chapter 7. Detailed Geology north of the Clarion river, 151
Richland township, ... 152
Salem township, ... 155
Beaver township, ... 156
Ashland township, ... 168
Elk township, ... 169
Paint township, ... 173
Highland township, ... 174
Knox township, ... 176
Washington township, ... 180
Farmington township, ... 182
Chapter 8. Clarion oil district, ... 187–194
Area, ... 187
Dip of 3rd Oil sand, ... 188
Oil sand group, ... 189
Production, ... 190
Actual cost of oil produced, ... 193
Chapter 9. The Charcoal Iron furnaces, ... 195–205
General considerations, ... 195
History of individual furnaces, ... 201

LIST OF ILLUSTRATIONS.

Page.
Plate I. Sections showing the Clarion coal split into two beds, ... opposite 50
Plate II. Colored Geological map of Clarion county.
Plate III. Sketch map in contours of the Parker ancient water-channel.
Plate IV. Map of the anticlinals and the oil district.
Plate V. A fault in the Kittanning Lower coal, . . . 144
Plate VI. Sections of the Conglomerate series, . . . 60–61
Plate VII. Contoured map of Brady's Bend. 66–67

SMALL CUTS IN TEXT.

Page.
Fig. 1. Sketch of old water course at Callensburg, . . 21
2. Productive coal measures, ... 32
3. Freeport group. Enlarged, generalized section, 33
4. Freeport Upper coal, ... 35
5. Freeport Upper sandstone, general section, . . 37
6. Freeport Lower coal, ... 39
7. Kittanning group (enlarged), ... 42
8. Kittanning Middle coal, ... 44
9. Kittanning Lower coal (a), ... 46
10. Kittanning Lower coal (b), ... 47
11. Kittanning Lower coal (c), ... 47
12. Northern section Clarion group (enlarged), . . 51
13. Southern section Clarion group (enlarged), . . 52
14. Clarion Lower coal, ... 55
15. Conglomerate series and No. XI (see Plate VI), 59
16. Oil-Sand group, ... 189
17. Red Bank section, ... 69
18. Red Bank furnace coal bank (*a*), ... 71
19. Red Bank furnace coal bank (*b*), ... 71

Page.
20. Lawsonham section, Madison T., . . 71
21. T. Ramsey coal bank, " . . 74
22. Catfish coal bank, " . . 75
23. Catfish section, " . . 76
24. Lower Hillville section, " . . 77
25. Robt. Murphy coal bank, Toby T., . . 79
26. T. Murphy coal bank, " . . 79
27. Section on Wildcat run, " . . 81
28. Sommerville coal bank, " . . 81
29. Sligo branch coal bank, " . . 83
30. Steven's coal bank, " . . 83
31. Courson coal bank, " . . 85
32. New Bethlehem section, Porter T., . . 88
33. Goheen's upper coal bank, " . . 89
34. Goheen's lower coal bank, " . . 90
35. Lowrie's coal bank, " . . 90
36. Smullen's coal bank, " . . 92
37. Wilkin's or McClure's coal bank, " . 93
38. St. Charles Furnace coal bank, " . . 94
39. Ditty's coal bank, " . . 94
40. Wills' coal bank, " . . 97
41. Fairmount section, Red Bank T., . 99
42. Fairmount coal bank, No. 1, " . . 100
43. Diagram showing reversed dip, " . . 100
44. Fairmount coal bank, No. 4, " . . 105
45. Wilhelm coal bank, " . . 107
46. Section northeast of Fairmount, " . . 107
47. Shannondale section, " . . 109
48. Songer's coal bank, " . . 111
49. Section at Patton's Station, " . . 116
50. Putney coal bank, Perry T., . . 119
51. Switzer coal bank, " . . 120
52. Yingling coal bank, " . . 120
53. McCall coal bank, " . . 120
54. West Freedom section, " . . 121
55. Miller's Eddy section, " . . 123
56. Snyder coal bank, " . . 124
57. Elliot coal bank, Licking T., . . 126

Page.
58. Frampton farm section, Licking T., . . 126
59. Frampton coal bank, " . . 127
60. Sligo section, Piney T., . . 128
61. Beers coal bank, " . . 130
62. Fox coal bank, ... " . . 131
63. Fox farm section, " . . 132
64. Cribbs farm section, Monroe T., . . 137
65. Sloan farm section, Limestone T., . 138
66. Sloan coal bank, " . . 139
67. Stewart coal bank, " . . 140
68. Fleming coal bank, Clarion T., . . 141
69. Corsica section, " . . 142
70. Section east of Clarion, " . . 143
71. Young coal bank, " . . 143
72. Mill Creek section, Mill Creek T., . 147
73. St. Petersburg section, Richland T., . 153
74. Edenburg section, Beaver T., . . 158
75. Smith and Barnett coal banks, " . . 159
76. Barnett coal bank, " . . 159
77. Delo banks, " . . 160
78. Helen Furnace section, Highland T., . 175
79. Coal bank near Helen Furnace, " . . 175
80. Lucinda Furnace section, . . Knox T., . . 177
81. Lucinda coal banks, " . . 177
82. Fryburg section, Washington T., 181
83. McMichael's coal bank, " . . 182

REPORT OF PROGRESS,

VV.

CLARION COUNTY.

CHAPTER I.

Area; population; railroads; soil and surface rocks.

§ 1. Lying east of the Allegheny river, its southern boundary but six miles north from an east and west line drawn through the middle of the State, Clarion county may be said to occupy a central position in Western Pennsylvania.

It was created a separate county by act of March 11th, 1839, from parts of Venango and Armstrong counties, which were then in juxtaposition along the Clarion river or Stump creek as it was originally called.

The shape of the county is nearly square but its boundaries are very irregular, as may be seen from the following short description:—

§ 2. *Boundaries.*—Beginning at a point about one-half mile east from the northeast corner of tract No. 3323 in Farmington township thence southwardly,—parallel to the old tract surveys,—to Red Bank creek; thence down Red Bank creek to its junction with the Allegheny river; thence up the Allegheny river to the mouth of Ritchie run, thence along Ritchie run about one and a half miles, thence in an irregular broken line to the southwest corner of tract No.

2498 in Ashland township, thence northwardly to the northwest corner of tract No. 2526, thence east to the northeast corner of tract No. 2525, thence north the width of one tract, thence east to the northeast corner of tract No. 2538, thence north to the northwest corner of tract No. 2803, thence east to the southwest corner of tract No. 2819, thence north to the northwest corner of tract No. 2829, thence east to the northeast corner of tract No. 2832, thence south to the northwest corner of tract No. 3674, thence east to the starting point.

§ 3. In the original Act of Incorporation the northwestern boundary was defined as a straight line from Farmington township southwestwardly to Ritchie run. This line running diagonally across the old tract surveys, was found to be troublesome on account of the difficulty of locating exactly its intersection with the established farm lines, and it was subsequently replaced by the present irregular line.

§ 4. *Area.*—The average length of the county is twenty-five miles and its breadth twenty-four miles. With the material in hand it is impossible to calculate its exact area, but it can be approximately estimated at about five hundred and ninety-five square miles.

§ 5. It is divided into twenty-two townships arranged in an irregular order thus:

Farmington.
Washington.
Ashland. **Knox.**
Elk.
Highland.
Salem.
Beaver. **Paint.**
Mill Creek.
Richland.
Clarion
Piney. **Limestone.**
Monroe.
Licking.
Perry.
Toby. **Porter.** **Red Bank.**
Madison.
Brady.

§6. *Population.*—The population of this county has increased by peculiar spasmodic growths, very different from the steady augmentation that generally accompanies agricultural settlement.

The first settlement was made in 1801 or 1802, and from this time up to 1835 the population steadily increased until it reached about 10,000. In 1840 it was estimated at over 15,000, and in 1850 at 23,565; while in 1860 it was not quite 25,000, and in 1870 the census showed 26,537. In 1877 it was probably at least 38,000.

§ 7. An analysis of these figures developes several points of interest to the geologist, as they can be made to show very strikingly the influence of the natural resources of the country upon its growth and settlement.

Tabulating the above dates and figures thus:

Date.	Population.	Increase.	Years.	Gain per year.
1801, . . .	0			
1835, . . .	10,000	10,000	34	294
1850, . . .	23,565	13,565	15	904
1870, . . .	26,537	2,972	20	148
1877, . . .	38,000	11,468	7	1,637

It becomes at once evident that the very large gain per year from 1835 to 1850, and from 1870 to 1877, must have been due to some other agency than that of *bona fide* agricultural settlement. If a further analysis of the gain per year be made by assuming that from 1835 to 1850 the increase from agricultural settlement was equal to that from 1801 to 1835, and that from 1850 to 1870, this gain was but 148 per year, the table then stands thus:

Period.	*Agricultural Gain.*	*Iron and Oil.*	*Total Gain.*
1801–1835;	294	+ 0	= 294
1835–1850;	294	+ 610	= 904
1850–1870:	148	+ 0	= 148
1870–1877;	148	+1,489	=1,637

Showing a gain, aside from that of the farming community, from 1835 to 1850, of 610 per year; and from 1870 to 1877, of 1,489 per year. The rapid growth from 1835 to 1850 is plainly attributable to the iron and lumber manufactures; while that of 1870–77 has been entirely due to the rapid development of the oil territory.

§ 8. Between 1835 and 1850 about thirty charcoal furnaces were built and put in operation within the limits of the county. Each of these required an average of 130 men, besides attracting to the spot store-keepers, millers, hotel landlords, and artisans from many different trades. Assuming that twenty-five of these furnaces were in blast, with their full quota of employees, the total number thus supported would be 130×25=3,250 male adults. These 3,250 men probably represented a total population (including women and children) of about 9,000. The increase thus calculated, taking place gradually in the fifteen years, if averaged throughout that period, shows a gain of 600 per year, which agrees very well with the figures of the above table.

The total extinction of the charcoal iron industry in this county occurred between 1850 and 1870, and large numbers of those employed at the furnaces and mines sought employment elsewhere. This exodus was counterbalanced by an influx of lumbermen; otherwise an actual decrease in the total population would have occurred during that period. Then, in 1870, when the lumber business was waning, and the population threatened with a sudden and lasting decrease, came the discovery of the oil territory, immediately followed by a large influx of speculators, merchants, laborers, drillers, and artisans. This sudden rise reached its zenith in the fall of 1877, and since then there has been a steady decrease, caused by the exhaustion of much of the best territory, and the alluring prospects presented by the Bradford oil district. The present population [January 1, 1880] is probably less than 30,000.

§ 9. *Railroads.*—The county is well supplied with railroads, containing at present within its limits more than ninety miles of operated road.

The Allegheny Valley railroad, running from Pittsburgh to Oil City, runs along the eastern edge of the county from Red Bank to Emlenton, and its "Extension," more commonly known as the Low Grade or Bennett's Branch road, running from Red Bank to Driftwood on the Philadelphia and Erie railroad, passes up Red Bank creek, keeping on the Clarion (north) side of the stream the whole width of the county. At Long Bend, two miles west of New Bethlehem, the cars pass through a short tunnel, which lessens by several miles the distance to be traveled. The summit, at the neck of this loop or bend, is quite low. Its shape shows very clearly how such a bend can be cut off by the undercutting erosion on opposite sides of the loop. In Chapter 2 a description is given of two such loops that have been cut through and abandoned—one at Parker, and one at Callensburg.

§ 10. The Sligo Branch railroad, now a branch of the Allegheny Valley railroad, makes a junction with the Low Grade road at Lawsonham. This road runs north from Lawsonham to Sligo, passing near Reimersburg.

§ 11. Two narrow gauge railroads, now both operated under one management, have lately been built along the line of the oil development.

The Emlenton and Shippenville railroad, starting from the valley of the Allegheny river at Emlenton, climbs the steep river hills by a heavy grade up Ritchie run, and runs across the country to Clarion, passing near Turkey City, Monroeville, Pickwick, Beaver City, Edenburg, Elk City, and Shippenville.

The Foxburg, St. Petersburg and Clarion railroad has its terminus at Foxburg. It climbs the river hills by a series of switch-backs, and running through St. Petersburg makes a junction with the former road at Jefferson Furnace.

§ 12. *Soil.*—The northern and southern halves of the county present very unlike agricultural facilities. In the northern townships sandy and often cold clayey soils, of the Conglomerate series, cover most of the surface; but where any considerable thickness of the coal measures with the Ferriferous limestone is caught in the hilltops, soil of much better quality is found.

Through the greater part of Highland, Farmington, Paint and Beaver townships the soil is usually quite poor.

§ 13. South of the Clarion river there is much excellent farming land, indeed some that may be called really first class. The best of this occurs in Red Bank, Porter, Limestone, Monroe, Toby, and Licking townships, and is made from the disintegrated shales and friable sandstones of the Kittanning and Clarion groups. It is always better where the Ferriferous limestone is present, than over those areas in which that stratum is wanting. Much very fair soil is found in all of the remaining townships south of the Clarion river, some of which occurs where the strata of the Freeport group occupy the surface. The highlands in Madison, Porter and Toby townships are of this character.

§ 14. The use of lime on most of these soils is attended with good results, a fact which the residents of the county generally seem to appreciate. In some instances it is applied *too freely*. The Clarion county soils apparently do best on *frequent but moderate* applications, being in this respect very dissimilar to the soils of Butler county made from the same rocks.

§ 15. *Timber.*—The charcoal iron furnaces used an enormous amount of timber, and what little they left has been nearly exhausted. In Farmington, Highland, Paint, and Mill Creek townships some few small tracts of merchantable timber still remain, but these are rapidly being depleted, so that in a few years, at furthest, the lumbering interests of this county will be small.

§ 16. *Surface rocks.*—The strata outcropping in Clarion county are printed in full face type in the following table, which is here introduced to show their position in the Pennsylvania geological column or series of rocks.

§ 17. By reference to the colored *Geological map* it will be seen that the *Coal measures* occupy most of the surface of the county. The *Barren measures* are shown by the small dark patches in the southern row of townships.

The Ferriferous limestone, lying near the base of the coal measures, has been represented on the map by a blue line. It presents more than four hundred and fifty linear miles of outcrop within the county limits.

The Conglomerate series of sandrocks is indicated by the lighter tint. It covers large areas in the northern townships, but in the southern townships usually lies low down along the side slopes of the valleys.

XV.	Upper Productive Coal measures.
XIV.	BARREN MEASURES.
XIII.	LOWER PRODUCTIVE COAL MEASURES.
XII.	CONGLOMERATE MEASURES.
XI.	MAUCH CHUNK RED SHALE.
X.	POCONO (VESPERTINE) SANDSTONE.
IX.	Red Catskill.
VIII.	Chemung and Portage.
	Hamilton.
	Corniferous Limestone.
VII.	Oriskany Sandstone.
VI.	Lower Helderburg Limestone.
V.	Clinton Red Shale.
IV.	Medina Sandstone.
	Oneida Conglomerate.
III.	Hudson River Slates.
II.	Lower Silurian Limestone.
I.	Potsdam Sandstone.

§ 18. *The Mauch Chunk red shale* is a few feet above water level at Cooksburg on the Clarion river, and at Patton's station on Red Bank creek; but the exposures are not sufficiently good to show whether *No. X*, the *Pocono sandstone*, is represented by the strata underlying the red shale of XI, but the presumptive evidence in favor of this view is very strong and in the absence of any antagonistic facts it seems safe to conclude that these rocks are a part of No. X.

It is impossible, in the present state of our knowledge, to tell how far below water level the various underlying formations would be struck in a drill hole; for we do not know the rate at which these rocks thin toward the west and northwest. But from the rates of dip throughout the oil district, it seems certain that the Corniferous limestone lies at least 3,500′ below water level; it *may* be 5,000 feet beneath the surface. At the face of the Allegheny mountains, where all these rocks are brought up and exposed to view, the Lower Silurian limestone lies 16,400 feet (geologically) beneath the lowest workable coal bed, but this is no exact index to its depth beneath the same coal bed in Clarion county.

§ 19. *Ores.*—In this, as in other counties in this part of the State, impostors appear from time to time, who claim the discovery of copper, silver, gold, lead or zinc ores. It may happen that persons are deluded by finding pyrites or siderite crystals or perhaps small fragments of galena; but in most instances it is evident that their purpose is to impose upon the credulity or ignorance of others. It is almost needless to say that such ores have never been found (unless the locality was "salted") nor need they be looked for in the rocks of Clarion county. It is beyond doubt true that isolated cubical crystals of galena (sulphide of lead) have been found at many localities in the coal measures; but these are *never* present in sufficient quantity to be termed an "ore." They must be regarded as mineralogical (or geological) curiosities.

A description of the Clarion county iron ores will be found in the chapter on Charcoal Iron Furnaces.

CHAPTER II.

Topography and Drainage.

§ 20. *The surface of the* country bordering the Allegheny river, Red Bank creek and the Clarion river is rough and rugged with steep, sometimes precipitous descents to water level: it might well be termed mountainous. Receding from the main water courses toward the dividing ridges the country becomes less rugged, though still decidedly hilly; but in some townships,—as for instance, Clarion township,—the surface is much smoother, and presents a gently undulating appearance which entirely hides the cañon-like gorge of the Clarion river.

§ 21. *The summits* along the divide between Red Bank creek and the Clarion river range from five hundred to six hundred and twenty-five feet above water level in Red Bank creek, or 1525 to 1650 feet above ocean level. The high peak two or three miles west of Shannondale is about 1725 or 1750 feet (by barometer) above ocean level. The descent from this divide to Red Bank creek is much sharper than the north slope towards the Clarion river.

§ 22. *The summits* of the *northern* townships are rather lower than those *south of the Clarion*, averaging generally from 1500 to 1600 feet above ocean level; but on reaching the extreme northern edge of the county they culminate near Fryburg in a series of bold ridges reaching from 1750 to 1775 above ocean level. *The descent* from this divide to the Clarion river is quite gradual to within a short distance of the river, when it pitches off in an almost precipitous slope three hundred feet high.

§ 23. *The geological map* shows these general topographical features, though not so well as a contoured map would; for while the color lines on the map resemble contours they are not equivalent to them; for the strata whose limits they define are not horizontal, but dip gently to the south,—sometimes towards the northwest. Again, the Ferriferous Limestone,—shown on the map by a blue line,—is absent over large areas in which the hills are high enough to contain it, and this at first sight conveys the idea of *low ground* over that area. But notwithstanding these drawbacks the coloring is in general a good index to the topography. The darkest tint on the map shows the higher summits capped by the Barren Measures; the intermediate tint indicates the area covered by the Lower Productive Coal Measures, with the blue line of the Ferriferous Limestone, nearly five hundred miles long, near its base; while the lighter tint represents the extent of the outcrop of the Conglomerate Measures.

The red line on Red Bank creek near Maysville and along the Clarion river and its branches from Clarion to the Forest county line represents the *Mauch Chunk Red Shale.* This formation lies very nearly at water level and its base cannot be determined with any degree of accuracy. The light tint between water level and the red line indicates the underlying *Pocono* or *Vespertine* strata. It is not certainly known how much of the Pocono comes above stream level, for it may be that the red shale occupies nearly all the interval from the base of the Conglomerate Measures to water level.

The outline of the geological map was obtained by reduction from the township maps of Caldwell's Clarion County Atlas, which were found reasonably correct.

Railroad Elevations.

The following tables of railroad elevations have been copied from reports N and I.I. The levels of the Sligo Branch railroad have been raised five feet to make them agree with the corrected elevation of Lawsonham junction.

§ 24. *Allegheny Valley R. R.*

From Pitts'g.	STATION.	Above ocean.
Miles.		
0.0	Pittsburgh,	745
28.8	West Penn junction,	791
44.5	Kittanning,	810
63.7	Red Bank junction,	851
65.9	Phillipsburg,	855
68.5	Brady's Bend,	857
71.0	Catfish,	859
72.6	Sarah Furnace,	861
74.0	Hillsville,	865
78.1	Monterey,	875
82.5	Parker,	889
85.2	Foxburg,	897
89.0	Emlenton,	905
106.7	Scrubgrass,	945
123.1	Franklin,	988
131.0	South Oil City, (1009.27,)	1009
132.0	Oil City, Union Depot, (1008.82,)	1008

§ 25. *Low Grade or Bennett's Branch R. R.*

Miles.	STATION.	Above ocean.
0	Driftwood Junction P. & E. R. R.,	814
16	Benezette,	1040
39(?)	Summit Tunnel,	1466
	Summit of hill above tunnel,	1678
54	Reynoldsville,	1377
69	Brookville,	1235
76	Troy,	1186
	Heathville,	1161
	Beaver run bridge, *top south capstone, east abutment,*	1161
	Robinson's loop bridge, *top south capstone, east abutment,*	1157
81	Patton's station, *top parapet coping of arch culvert, north side of road,*	1131
84	Maysville,	1108
	Pine run bridge,	1101
86	Millville,	1093
	Indian run bridge,	1090
88	Fairmount,	1086
90	New Bethlehem,	1080
91	Bostonia junction,	1074
	Anthony's bend tunnel, *west end,*	1051
95	Leatherwood station and bridge,	1027
	Rock run, *top parapet arch culvert, south side of road,*	964
	Buck Lick run,	939
104	Lawsonham,—junction, *bench on parapet coping south side of road,*	919
	Fiddler's run, *close to junction and Lawsonham station. Arch culvert, bench is 15' below road level,*	904
	Mortimer run, *bridge seat coping, east abutment, one mile from Allegheny river,*	848
	Red bank junction, A. V. R. R.,	851

§ 26. *Sligo Branch R. R.*

STATION.	Above ocean.
Lawsonham Junction, Low Grade R. R.,	919
Stops run,	941
Fiddler's run, *center of first trestle,*	994
9,000 feet, *from junction,*	1071
14,000 feet,	1169
15,000 feet,	1189
17,000 feet,	1230
23,000 feet,	1353
Benn's summit,	1396
29,000 feet,	1333
Cherry run,	1226
38,000 feet,	1246
Sligo summit,	1328
Iron ore bank,	1256
52,000 feet,	1178
Little Licking creek,	1150
Big Licking creek,	1130
Sligo,	1118
End of road,—*at Sligo,*	1113

§ 27. *Emlenton, Shippenville and Clarion R. R.*

NAME OF STATION.	Above datum.	Above ocean.
Emlenton,	0	905
King's station,	225.39	1130
Agnew's station,	348.49	1253
Buttertown station,	451.44	1356
McMichael's station,	541.59	1447
State Road,	496.34	1401
Turkey Run trestle,	301.67	1207
Turkey City station,	336.40	1241
Monroeville station,	557.70	1463
Summit,	594.15	1499
Pickwick trestle,	511.15	1416
Beaver Run trestle,	333.00	1238
Jefferson station,	337.00	1242
Beaver City station,	515.85	1421
Summit,	539.95	1445
Edenburg station,	471.00	1376
Canoe Creek trestle,	410.05	1315
Elk station,	508.35	1413
Summit,	561.20	1466
Dale City station,	530.20	1435
Deer Creek trestle, (Junction,)	329.90	1235
Shippenville station,	347.75	1253
Paint Creek trestle,	290.00	1195
Black's station,	337.50	1243
Patrick Farm station,	527.65	1433
Summit,	530.25	1435
Pike siding,	505.35	1410
Clarion bridge, (56′ to water,)	193.10	1098
Clarion,	583.60	1489

§ 28. *Foxburg, Shippenville and Kane R. R., (trial line.)*

STATION.	Above datum.	Above ocean.
Junction west of Shippenville,	0	1235
Jamestown,	304	1539
Lickingville,	345	1580
Tylersburg,	343	1578
Summit,	430	1665
Forest county line,	382	1617
Summit near road crossing,	469	1704
Marienville,	480	1715
Summit,	553	1788
Summit,	578	1813
Summit,	588	1823
Hollow,	500	1735
Summit,	674	1909
Elk county line,	666	1901
Run,	575	1810
Wilcox and Ridgway pike,	610	1845
Summit,	718	2053
Summit,	789	2024
Summit,	804	2039
Summit,	824	2059
Summit,	850	2085
Philadelphia and Erie R. R., about 3000′ east of Kane and 1500′ east of oil banks,	780.4	*2015

The elevations of the narrow-gauge railroads were obtained from profiles in the president's office, at Foxburg. They have been reduced to an ocean level datum from the corrected elevation of Emlenton, given in the above table § 24.

Oil Well Elevations.

The following list of oil well elevations in Clarion county is here republished from Report I.I to give a general idea of the topography along the oil-belt, and also as a table of reference for the use of those engaged in the production of oil. The left hand column of figures are simply the running index numbers of report I.I.

---

*Note.—This elevation of the P. & E. R. R at the point indicated is probably at least twenty feet too great, according to the mile post elevation of the P. & E. railroad, as obtained by Mr. Ashburner. Such discrepancies are always found in trial line elevations, and these must therefore be cautiously used, as we do not know what other errors may have been allowed to creep into the work.

§ 29. *Wells between Foxburg, St. Petersburg and Turkey City.*

Well No.	Name.	Locality.	Township.	Above ocean.
1536	Frazier,	—— ——,	Richland,	1153
1537	Gas Well,	—— ——,	do.	1138
1538	—— Well,	Rupert Farm,	do.	1175
1539	Ashbaugh,	Near St. Petersburg,	do.	1334
1540	Chambers,	do. do.	do.	1333
1541	Edinger, No. —,	N. E. of St. Petersburg,	do.	1324
1542	Edinger, No. —,	do. do.	do.	1280
1543	Ashbaugh,	do. do.	do.	1261
1544	Lone Walking Beam,	do. do.	do.	1238
1545	Hulings,	do. do.	do.	1191
1546	Holliday & Ritts,	Ritts Farm,	do.	1235
1547	Average of cluster of wells,	N. E. of St. Petersburg,	do.	1240
1548	Race Bros.,	Ritts Farm,	do.	1271
1549	Pioneer, No. 1,	Neely Farm,	do.	1213
1550	Victor Ritter,	Near Richland Furnace,	do.	1223
1551	Sold & Dallon, No. —,	do. do.	do.	1213
1552	Sold & Dallon, No. —,	do. do.	do.	1192
1553	Harley and Burzer,	do. do.	do.	1120
1554	Wise,	Caden Farm,	do.	1090
1555	McLaughlin,	Turkey Run,	do.	1100

§ 30. *Wells near Turkey City and Dogtown.*

1556	Lone Pine, No. 1,	Near Turkey City,	Richland,	1131
1557	Lone Pine, No. 2,	do. do.	do.	1130
1558	Faith,	do. do.	do.	1144
1559	Sanders,	do. do.	do.	1154
1560	Smith,	do. do.	do.	1167
1561	Alex. Panton,	do. do.	do.	1162
1562	Howard,	Weller Farm,	do.	1177
1563	Neal,	Near Turkey City,	do.	1186
1564	Brady,	do. do.	do.	1177
1565	Weller, No. 1,	do. do.	do.	1268
1566	Legal Tender,	do. do.	do.	1232
1567	Shammut,	—— ——,	do.	1319
1568	Mingo Chief,	Masters Farm,	Beaver,	1339
1569	Baldy,	do. do.	do.	1334
1570	Forest City, No. 1,	—— ——,	do.	1361
1571	Dutch,	Masters Farm,	do.	1410
1572	Masters (?),	do. do.	do.	1418
1573	Hermage,	do do.	do.	1450
1574	Ray & Miller, No. 1,	Near Dogtown,	do.	1459
1575	Harold,	do. do.	do.	1483
1576	Last Chance,	do. do.	do.	1474
1577	Contest,	do. do.	do.	1468
1578	Stewart, No. 1,	do. do.	do.	1498
1579	McNulty,	do. do.	do.	1502
1580	Hardison,	do. do.	do.	1511

§ 31. *Wells between Dogtown, Pickwick and Triangle.*

Well No.	Name.	Locality.	Township.	Above ocean.
1581	Allhouse & Guffey,	Hummel Tract,	Salem,	1487
1582	——— Well,	do. do.	do.	1473
1583	Gilbert, No. 2 (?),	do. do.	do.	1451
1584	Martin & Myers,		do.	1475
1585	Harvick,	Hummel (?) Tract,	do.	1454
1586	Smith Cook, No. 3,	Pickwick,	do.	1417
1587	Hummel,	do.	do.	1381
1588	Hickory Shade,	do.	do.	1399
1589	McDevitt,	Near Pickwick,	do.	1416
1590	Andrew Reid,	do. do.	do.	1407
1591	Harley Bros.,	do. do.	do.	1390
1592	Triangle City,	Cropp Farm,	do.	1376
1593	Fertig,	do. do.	do.	1373
1594	Rush & Green,	do. do.	do.	1379
1595	Harley Bros.,	Delo Farm,	do.	1389
1596	Keily Bros.,	Cropp Farm,	do.	1403
1597	Allhouse & Cuner,	N. W. of Pickwick,	do.	1366
1598	Wetter,	do. do.	do.	1373
1599	Hard Scrabble,	do. do.	do.	1315
1600	Thompson,	do. do.	do.	1368
1601	Sherman,	Wid. Kribbs Farm,	do.	1404
1602	Guyer,	N. W. of Pickwick,	do.	1326

§ 32. *Wells near Pickwick and Edenburg.*

1603	Calamity,	Wid. Kribbs Farm,	Beaver,	1464
1604	Kiley Bros.,	Sam. Beals Farm,	do.	1433
1605	Kiley Bros.,	Beals (?) Farm,	do.	1430
1606	Church,	T. H. Axley Farm,	do.	1459
1607	Van Scovil,	S. W. of Edenburg,	do.	1441
1608	Wetter,	do. do.	do.	1492
1609	McKay, No. 4,	do. do.	do.	1443
1610	——— Well,	Haney Farm,	do.	1402
1611	——— Well,	Bowers Farm,	do.	1443
1612	Horn Well,	In Woods,	do.	1445
1613	Wynkoop & Co.,	Mendenhall Farm,	do.	1408
1614	——— Well,	do. do.	do.	1466
1615	Moran, No. —,	do. do.	do.	1336
1616	Moran, No. —,	do. do.	do.	1390
1617	Goss Bros., No. 1,	J. Best Farm,	do.	1550
1618	Swetzer, No. 2,	Edenburg,	do.	1548
1619	Chambers, No. —,	N. Knoll Farm,	do.	1537
1620	Chambers, No. —,	do. do.	do.	1560
1621	Turner & Co.,	North of Edenburg,	do.	1403
1622	Gray,	do. do.	do.	1367
1623	McGuire & Co.,	do. do.	do.	1355
1624	Antwerp Pipe Co,.	do. do.	do.	1354
1625	St. Lawrence,	do. do.	do.	1396
1626	Detroit,	do. do.	do.	1396
1627	Balliot & Lee, No. 2,	do. do.	do.	1375
1628	Snooks, No. —,	Near Edenburg,	do.	1347
1629	Snooks, No. —,	do. do.	do.	1342
1630	Painter & Warner,	do. do.	do.	1290
1631	Bradley, No. —,	do. do.	do.	1349
1632	Bradley, No. —,	do. do.	do.	1296

1633	Hulings, No. —, . . .	Near Edenburg, ...	Beaver,	1358
1634	Hulings, No. —, . . .	do. do.	do.	1325
1635	Grant & Aikins, . . .	do. do.	do.	1406
1636	Black, ...	Black Farm, ...	do.	1380
1637	Hope, ...	Near Shippenville, . . .	Elk,	1324
1638	Gray Bros., ...	do. do. . . .	do.	1410
1639	Berlin Gas Well, . . .	North of Shippenville, .	do.	1423
1640	G. W. Berlin, ...	do. do. .	do.	1404

Drainage.

§ 33. *The drainage system* of the county is naturally divided thus:

1st. Streams flowing *north* into the Tionesta and Allegheny.

Clarion—Allegheny Divide:

2d. Streams flowing *south* into the Clarion river.

3d. Streams flowing *north* into the Clarion river.

Clarion—Red Bank Divide:

4th. Streams flowing *south* into Red Bank creek.

§ 34. *The Clarion, Allegheny and Tionesta Divide*, is a continuation of the "Big Level" of McKean and Forest counties. It enters the county about one mile south of the northeast corner of Farmington township and runs southwestwardly through Farmington, Washington, Elk, Ashland, and Salem townships, passing near Tylersburg, Jamestown, and Mount Pleasant, to Salem; thence southwardly to its terminus in Richland township. The principal streams rising on its north slope are Coon creek, Hemlock run, East Sandy and Little Sandy; those on its south side are Tom's run, Toby creek, Paint creek, Deer creek, Canoe creek, Beaver creek, and Turkey run. These streams have an average fall from source to mouth, of from thirty to forty feet per mile.

§ 35. *The Clarion and Red Bank Divide* enters the eastern edge of the county from Jefferson county near Corsica, runs southwestwardly to the middle of the south line of Limestone township, thence through the southern part of Monroe, and west by southwest through Porter township to Reimersburg, thence northwest to its terminus near West Freedom in Perry township. Mill creek, Piney creek, Licking creek, and Cherry run are the principal streams on its north side; on the south side we find Town run, Leasure's run, Leatherwood creek and Catfish run. The last named streams have a very steep fall from source to mouth which ranges from fifty to one hundred feet per mile.

§ 36. *The Clarion river.*—This stream has been invaluable to the lumber interests of Forest, Jefferson and Clarion counties. On account of its great importance to both the lumber and iron manufactures, it was made a public highway by act of assembly.

From Cooksburg on the Jefferson and Forest county line to its junction with the Allegheny river, it has *an average fall of seven feet per mile.* Its banks are steep; often so precipitous as to be difficultly accessible. The Conglomerate series of sandrocks occupy these side-hills, but though the slopes are so abrupt, good exposures of these rocks are quite rare.

The basin drained by the Clarion river in this county aggregates about three hundred and seventy-five square miles; equal to five-eighths of the total area of the county.

§ 37. *Red Bank creek.*—This stream has been and still is valuable as an outlet to the lumber manufactured in this and in Jefferson county. From Patton's station near the eastern edge of the county to Red Bank junction, it has a fall of about *nine feet per mile.*

Ancient water course near Parker.

§ 38. In driving east from Parker along the road leading to West Freedom, a strikingly broad and open valley is seen, and in it a small sluggish stream, entirely disproportionate in size to the breadth of the valley.*

At Hagerstown the wagon-road crosses this valley which here bears off to the northeast, but bending around to the south-east it is again crossed by the road one mile from West Freedom.

---

*The sketch map in twenty-foot contour curves [Pl. III] exhibits all the main features of this old valley, and though by no means an accurate map will probably be of service in connection with the accompanying description.

Leaving the main road and following the valley for half a mile toward the southeast *a summit is reached* on the south side of which another stream heads and flow southeastwardly to the Allegheny river through a valley similar to the first. The divide is in swampy ground.

§ 39. *At Perryville* the north side of the valley is steep and the south side of more gentle contour, but at Hagerstown the reverse is seen, while throughout the back of the bend on either side of the summit, the inside of the loop presents gentle slopes facing the more precipitous rock-covered declivities surrounding its outer border.

The summit of this old valley is about 1090 feet above ocean level or *two hundred and fifty feet* more or less *above low water* in the Allegheny river at Parker. It has been cut down into,—if not entirely through,—the Homewood sandstone, which outcrops in the valley wherever the side slopes are steep enough to expose it.

§ 40. The valley is filled throughout by a deposit of river silt containing a small percentage of *glacial drift*, evidently re-worked and re-deposited by fluviatile action. This silt consists of sand, gravel, and clay beds irregularly though truely stratified: the counterpart of the silt found along the present channel of the Allegheny river. The coarser *gravel beds* in which water-worn fragments of the Coal measure and Conglomerate rocks largely predominate, are *sometimes consolidated* by a calcareous cement, thus being converted into *recent conglomerates*, similar to those seen along Oil Creek valley.

§ 41. A short distance below Hagerstown the stream *cuts through the drift* into the subjacent rocks, through which its descent is very rapid to the Allegheny river near Parker. The same feature is noticeable on the opposite side of the loop, where the stream cuts through the drift near the Monterey road crossing.

§ 42. The almond shaped hill enclosed by this valley and the Alleghey valley rises nearly *one hundred and fifty feet above the drift deposit.* It contains the Ferriferous limestone and its underlying coal beds.

A magnificent view of both sides of the valley, and its included island, may be obtained from the summit of the road leading to West Freedom, at a point one-half mile west from that town.

§ 43. That this old valley was once part of the Allegheny or Clarion river channel cannot be doubted. It evidently formed an oblong loop or bend that was probably cut through by an excessive undercutting erosion on the two opposite sides of the neck or narrowest part of the loop, just as the river is now slowly eating its way through the neck of Brady's Bend. This action may have been facilitated by the ice riding over the neck of the loop.

As soon as the river found a vent through the loop the old channel was abandoned; but during high water, and before the river had appreciably lowered its level, this old bend must have been a back channel, with more sluggish current than the new cut. Under these conditions it was probably filled with the drift it now contains.

§ 44. But the present level of the Allegheny and Clarion rivers is at least two hundred feet beneath bed-rock in the old channel, and as the river is now flowing on a false bottom fifty feet, more or less, above the true bottom of the valley, it is evident that the old channel is *two hundred and fifty feet above the true bottom of the Allegheny valley at Parker;* or in other words the Allegheny river has *eroded* a valley *two hundred and fifty feet deep*, and subsequently *refilled it to a depth of fifty feet* since the old channel was abandoned by the main stream.

§ 45. As the silt filling the abandoned water course contains some *glacial drift*,—pebbles worn from the Eozoic rocks of Canada,—it follows that the river did not entirely abandon this channel until the *commencement* of, or sometime *subsequent to the glacial period.* The river, then, must have accomplished the erosion of this deep gorge and a partial refilling of it,* since the commencement of the glacial epoch, or possibly in less time.

§ 46. But while the river has deepened its channel more than two hundred feet during this period, the general level of the uplands has apparently suffered very little denudation. This is shown by the comparatively undisturbed position of the glacial and fluviatile drift as seen at many localities in Venango, Butler and Clarion counties. The disproportion thus shown between the surface erosion and the erosion of the larger valleys has probably resulted from a large increase in the size of the Allegheny, consequent upon its receiving as tributaries streams that in pre-glacial times flowed north into Lake Erie, and also to large quantities of water furnished by the melting glaciers.

---

* This refilling may have taken place during a comparatively recent flooding of the Allegheny water basin.

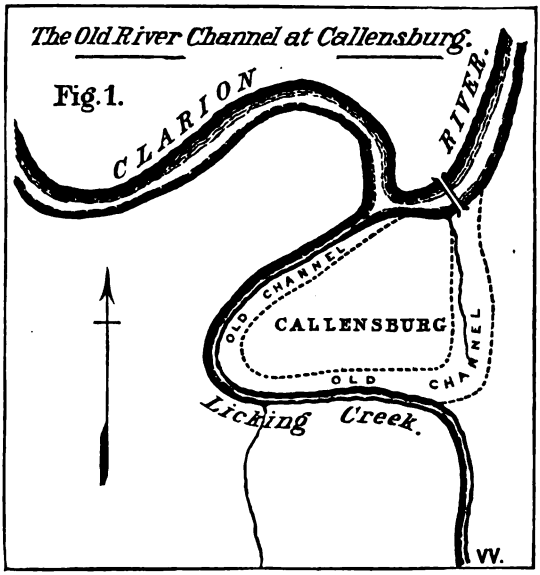
Prior to the glacial period the Clarion river was as large if not larger than the Allegheny. The impetus of its current flowing southwestwardly into the Allegheny, carried the main stream far across the present stream bed and over the high flats north of Lawrenceburg, thence sweeping southwardly and finally to the southeast it entered the old channel at Perryville around which it swept to the mouth of Bear creek. South of the latter point the river now occupies the site (at a lower level) of the old channel.

It might at first sight seem that these data would enable us to approximately calculate the age of the glacial epoch, but since we have no unit of erosion by which to measure, it is useless to attempt further analysis of them. Indeed from the nature of this erosion through nearly horizontal strata, a constant unit of erosion,—assuming an approximately uniform flow of water,—could not exist, for the rocks through which the river has cut its channel constantly vary in character and refractoriness.

The Callensburg Ancient Channel.

§ 47. Callensburg is situated on an isolated ovoidal eminence around which the Clarion river once flowed in a horseshoe bend. The neck of this loop was located between the present site of the county bridge and the mouth of Licking creek.

§ 48. *Licking creek* formerly emptied into the river *at the head* of the old loop near Mr. Colwell's place, but now occupies as its own the main channel through which it flows around Callensburg, and empties into the Clarion from the southwest meeting that stream full in the face. A small stream rises at the extremity of the old bend near Mr. Colwell's house and flows along the north side of the loop to its junction with the present channel near the bridge.



The Old River Channel at Callensburg.

Fig. 1.

The *summit or divide* between this run and Licking creek is not more than *ten or fifteen feet above creek level*, and the whole descent to river level is probably *less than fifty feet.* From these figures it is evident that the desertion of this loop by the river occurred at a much *later* date than that at Parker.

The accompanying illustration, Fig. 1, shows the situation of the old channel and the present course of the river, the current of which flows from *right to left* and not from *left to right* as the appearance of the figure would at first sight indicate.

Glacial Drift.

§ 49. I have observed no glacial drift *in situ* within the Clarion county limits. That found in the old channel at Parker, in the terraces along the river hillsides, and in the bottom of the river valley has evidently been re-worked and re-deposited by the river from areas of true glacial drift lying further north,—probably from Venango, Crawford and Warren counties.

It is always largely intermixed with local detritus, indeed it usually forms but a small part of the whole mass and generally consists of very small, more or less waterworn fragments of the older rocks. With few exceptions the pebbles are rounded and smoothed as by prolonged rolling, showing an amount of attrition rarely attained by true glacial drift.

CHAPTER III.

ANTICLINALS AND SYNCLINALS.

§ 50. In the reports of the First Geological Survey we find a description of two well marked synclinal and one anticlinal axes. These were designated respectively the "Fifth bituminous coal basin," the "Brady's Bend" or "Sixth anticlinal axis," and the "Sixth bituminous coal basin," the trough of which is sometimes called the Brady's Bend synclinal. In Report V, I have already shown the existence of several minor flexures traversing the Sixth basin. One of these—the Millerstown anticlinal and synclinal axis—prolongs itself through Armstrong into Clarion county.

The recent survey of Clarion county has disclosed the existence of several hitherto unknown anticlinal and synclinal axes.

§ 51. The numerical nomenclature adopted by the First Survey has been discarded in this report; and for obvious reasons. Between the so-called "Fifth basin" and Sixth anticlinal, we find two distinct anticlinals and synclinals, for which, if we adhere to the old nomenclature, we can devise no appropriate names. For this reason it seems better to discard entirely the old names and substitute a local (geograpical) nomenclature. After consultation with Mr. W. G. Platt it became evident that the Clarion county axes had their complete equivalents in Armstrong county, and for the sake of unformity we decided upon the following names for use in both counties. In selecting these, the names of localities along Red Bank creek were chosen in preference to any others. They are given below in the order in which they appear on the map, commencing at the north.

Millerstown	synclinal,	("Sixth basin.")
Millerstown	anticlinal,	
Brady's Bend	synclinal,	
Brady's Bend	anticlinal,	("Fifth axis.")
Lawsonham	synclinal,	("Fifth basin.")
Kellersburg	anticlinal,	
Centreville	synclinal,	
Anthony's Bend	anticlinal,	
Fairmount	synclinal,	
Brookville*	anticlinal,	("Fourth axis.")

§ 52. Most of these flexures are crossed by the line of the Low Grade railroad, in going from Red Bank Junction to Patton's station.

The first axis crosses the creek a very short distance above the junction. This is the *Brady's Bend anticlinal.* From the crest of this axis eastwardly to Sligo Junction, at Lawsonham, a marked south dip is plainly shown, both by the rock-cuts and by the height above water level of the ferriferous limestone and its associate coal beds. The Kittanning Lower coal is only two hundred and fifty feet above railroad level in the *Lawsonham trough.* The conglomerate measures exposed along the railroad consist of extremely variable alternations of sandstone and shale, in which thin ore beds and impure coal seams are of frequent occurrence. These occur in the horizon at which we would naturally look for the Mercer and Connoquenessing groups.

§ 53. Going eastward from Lawsonham a steep rise in the measures carries us up to the crest of the *Kellersburg anticlinal.* The descent from this flexure into the Centreville synclinal is not steep; nor is the next rise to the *Anthony's Bend anticlinal* a very sharp ascent.

This latter axis crosses Red Bank creek near the tunnel. Its southeast dip, sharp and steep, soon carries us down into the Fairmount synclinal trough. The ferriferous limestone here comes down to water level, but rising again to the east it soon mounts the *Brookville anticlinal,* which crosses the creek near Patton's station. The Ferriferous limestone is here nearly three hundred and fifty feet above railroad level.

---

* This name has been adopted provisionally in this report, in advance of the identification of the axes in Clarion county, with its supposed prolongation through Jefferson.—J. P. L.

This well-marked anticlinal brings all of the Conglomerate measures far above water level, and on its crest the Mauch Chunk red shale (No. XI) is lifted some distance above railroad level.

§ 54. The course of these axes is shown by Plate IV, which being a *fac simile* of the geological map, can be laid upon or beneath it for comparison. The relation of the geology to the topography is thus easily seen. The following special description of the anticlinals and synclinals observes an order from southeast to northwest.

The Brookville (?) Anticlinal.

§ 55. This axis has been provisionally named after Brookville, because it seems probable that it is identical with an axis crossing the measures near that town; but should future work in Jefferson county show this assumption to be false, the name must be discarded. It enters the county near Patton's station, and running northeastwardly across the southeast corner of Red Bank township, soon passes out into Jefferson county. Tracing it southwest into Armstrong county, Mr. Platt has found that it shortly dies away and is replaced by other flexures.

The Fairmount Synclinal.

§ 56. This was called the "Fifth Basin" by the geologists of the First Survey. It enters the county between the mouths of Middle and Town runs near Fairmount, and running northeast through Red Bank township passes out into Jefferson county, just touching the southeastern corner of Limestone township. This axis again crosses Red Bank creek at Troy, in Jefferson county. It apparently dies away when traced northeastwardly through Jefferson county, for it can hardly be detected on the pike between Brookville and Corsica, and if present is very shallow. The geological map shows very prettily how the Freeport Upper coal is caught in the hilltops along the course of this basin in Red Bank township.

Anthony's Bend Anticlinal.

§ 57. This enters the county a short distance west of Anthony's Bend tunnel in Porter township, and running northeast, soon passes into Red Bank township, thence through Limestone township to Corsica, just touching the southeastern corner of Clarion township. Its north dip can be detected near Corsica, and also east of Centreville in Limestone township, and east of St. Charles Furnace in Porter township. Its south dip is very strong and sharp, amounting to over two hundred feet, but within the Clarion county limits its north dip seldom exceeds forty feet.

Centreville Synclinal.

§ 58. This axis was named by Mr. G. W. Platt, from the town of *Centreville, in Armstrong county*, near which it passes. By a happy coincidence it also passes close to *Centreville, in Limestone township, Clarion county*, so that the name is peculiarly significant and applicable to it in this county.

It enters the county a short distance west from the mouth of Leatherwood creek, in Porter township, through which it passes diagonally to the northeastern corner of the township, thence across Limestone and Clarion and into Mill Creek township from which it speedily runs out into Jefferson county. Its trough is plainly marked by north dips observed in coal banks near Centreville, and by the old iron ore workings at St. Charles Furnace. It is a shallow basin with not more than forty feet of dip on its south side.

Kellersburg Anticlinal.

§ 59. This axis enters the county near the junction of Madison and Porter townships; running northeast it passes close to Frostburg, enters Limestone township and passing through Greenville, runs on through Clarion and Mill Creek townships to Jefferson county. Its course through the last two townships cannot be accurately determined.

Lawsonham Synclinal.

§ 60. This is a broad gentle basin lying next east of the Brady's Bend synclinal. Its trough enters Madison township, near Lawsonham, and truncating the northwestern corner of Porter, the southeastern corner of Monroe, and the northwestern corner of Limestone townships, runs through the centre of Clarion and Mill Creek townships to its point of departure into Jefferson county. Its south dip can be seen at innumerable places along its course, but the north dip is rather gentle and cannot often be detected.

Brady's Bend Anticlinal.

§ 61. This, the "Fifth Axis" of the geologists of the First Survey, is one of the best known flexures of western Pennsylvania. Mr. White has traced it from the Ohio river, a few miles below Pittsburgh, up through Allegheny into Butler county. He describes it as running N. 40° E. After leaving Butler county it traverses Armstrong and enters Clarion county near the mouth of Red Bank creek. It runs northeast through Madison township passing a short distance east of Reimersburg, thence across the eastern part of Toby, and just touching the southeastern corner of Piney passes into Monroe township, where it can be recognized near Curllsville and Reidsburg. It then courses through the western parts of Clarion and Mill Creek townships, running close to the Clarion river, crossing which it just touches Farmington township and passes out into Forest county, near Cooksburg. Its course through Clarion county is curved, but this curvature is very slight,—though important.

§ 62. Prolonging it with this slight curvation into Forest county, we find that it should lie east of, but very close to Marienville, where in fact its north dip can be detected.

§ 63. In the final report of the First Survey it is defined as a straight line from McKean county to the Allegheny river. This construction threw it several miles east of Marienville. In that report it is also frequently confounded with the axis east of Lawsonham,—the Kellersburg axis of report H^5 and this report.

Brady's Bend Synclinal.

§ 64. This usually lies about a mile and a half or two miles northwest from the Brady's Bend anticlinal. Between Catfish and Red Bank its north dip amounts to seventy feet or an average of thirty-five feet per mile. This trough has already been described by several geologists, and especially by Prof. Lesley who has seen in it an explanation of the *modus operandi* by which the great loop in the Allegheny channel was formed at East Brady. His explanation is substantially this: That the river flowing southwardly *down* the dip was deflected on encountering an opposing *north dip;* but after finally eating its way for some distance into the obstruction was again turned, this time in a direction opposite to the first only to be again re-directed to the south and compelled to duplicate the work which at first it had almost accomplished. In report V, I have already shown that the Scrubgrass bend in the Allegheny also owes its origin to the existence of a synclinal flexure. It can easily be conceived how an anticlinal might effect a somewhat similar result. Anthony's bend and the now abandoned bend at Callensburg were undoubtedly produced either by the flexures that pass near or through them, or by the difficulty experienced by the stream in cutting its channel through a strong opposing dip.

§ 65. The Brady's Bend synclinal enters the county a short distance west of Phillipsburg in Brady township, through which it passes; touches the Allegheny south of Catfish and running through Madison, Toby, Piney, Clarion, Highland and Farmington townships, passes out towards Marienville in Forest county. Its north dip can be detected a short distance east of Sligo, west of Williamsburg and east of Clarion town and is again seen east of Helen fur-

and at Scotch hills in Farmington township. It probably lies west of and close to Marienville.

Millerstown Anticlinal.

§ 66. This axis is named from Millerstown in Butler county where it was first detected by a reversed dip in the oil sand.* After traversing Armstrong county it crosses the Allegheny river and enters Clarion county one mile below Monterey in Perry township ; running northeast it passes close to or through Callensburg in Licking township, and after traversing Beaver and truncating the southeast corner of Elk and the northwest corner of Paint townships is found near Lucinda in Knox township, and Tylersburg in Farmington township. Its north dip only amounts to some forty feet and may often be even less.

Millerstown Synclinal.

§ 67. This axis is not shown on the map. It usually lies from half a mile to a mile northwest of the Millerstown anticlinal minor axes.

§ 68. Other minor and always local rolls traverse the measures northwest of the Millerstown axis, but they are so slight that it is impossible to trace them out and arrange them systematically in series ; even if this could be done it would be worse than useless, burdensome to the memory, confusing to all and of value to no one.

§ 69. A rather sharp axis apparently runs through southeastern Venango county, passing close to the northwestern corner of Ashland township. Its synclinal evidently makes the sharp loop in the Allegheny river between Emlenton and the Scrubgrass bend.

A description of a gentle but well marked anticlinal and synclinal roll will be found in Report V, on pages 10 and 120, where it has been named the "Martinsburg Axis." Diligent search for the north dip of this flexure in the surface rocks of Clarion county gave only negative results, but this may have resulted from insufficient exposures and not from an absence of the axis itself. In Chapter VIII of this report, a description will be found of an apparent northwest by west dip in the productive oil sand, and one too of unusual strength, for it averages forty feet per mile, and in a direction *nearly coincident with the "strike,"* or line of no dip. This roll does not lie in exactly the position at which we would expect to find a prolongation of the Martinsburg flexure. If the two axis be identical, then the Martinsburg flexure must run more to the east than the axes farther south. The result of nearly all our recent tracings of these Bituminous coal basin flexures, seems to indicate that we can no longer adhere to our the belief in long axes of unbroken continuity, but must substitute for it a construction embracing anticlinals of broken integrity; stretching away *in échelon* for long distances, splitting, subdividing or entirely disappearing.

---

* See report V, page 10 and map.

CHAPTER IV.

Lower Productive Coal Measures.

§ 70. The Lower Productive coal measures in Clarion county are from three hundred and twenty-five to three hundred and fifty feet thick, with an occasional and exceptional diminution to somewhat less than three hundred feet. These measurements do not include the Mahoning sandstone, nor the shales or slates lying between it and the Freeport Upper coal, for these rocks are now included in the Barren measures.

§ 71. That the *Barren measures* once stretched over all, or nearly all of Clarion county cannot be doubted, but they have been so wasted by erosion that at present they are only found in the isolated summits of Red Bank, Porter, Madison, Perry and Toby townships, where they form a covering to the Freeport upper coal. This covering is usually rather soft shale, but in some of the higher summits, a portion of the Mahoning sandstone still remains as the cap-rock.

§ 72. The Coal measures lie between the Conglomerate series and the Barren measures, thus:

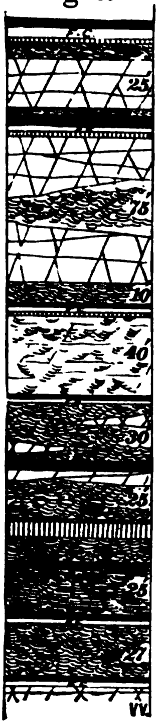
Lower Barren measures.
Lower Productive coal measures.
Pottsville Conglomerate measures.
Mauch Chunk red shale.

The systematized section illustrated by Fig. 2, conveys a better idea of the general arrangement of the coal series than is afforded by the detailed descriptions. It shows a total thickness of three hundred and thirty-five feet.

§ 73. *Generalized Section of the Productive Coal Measures.*

Freeport Upper coal, ...	4′
Fireclay, ...	5′
Freeport Upper limestone, ...	3′
Shale with ore, ...	8′
Freeport Upper sandstone, ...	25′
Shale, ...	4′
Freeport Lower coal, ...	6′
Fireclay, ...	2′
Freeport Lower limestone, ...	3′
Freeport Lower sandstone, with shale,	75′
Shale, ...	10′
Kittanning Upper coal, ...	2′
Fireclay or shale, ...	3′
Johnstown cement bed (limestone,) . .	2′
Shaly measures, ...	40′
Kittanning Middle coal, ...	2′
Fireclay, ...	2′
Shale with some sandstone, ...	30′
Kittanning Lower coal, ...	4′
Sandstone and shale with ore-balls, . .	25′
Ore,—carbonate of iron, ...	1′
Ferriferous limestone, ...	8′
Shale, ...	7′
Clarion Upper coal, ...	2′
Slaty shale, ...	25′
Clarion Lower coal, ...	3′
Fireclay, ...	2′
Shale, sometimes sandstone, ...	27′
Brookville coal, ...	2′
Fireclay, ...	3′
Homewood sandstone.	

Fig. 2.



§ 74. The above section may be systematized thus:

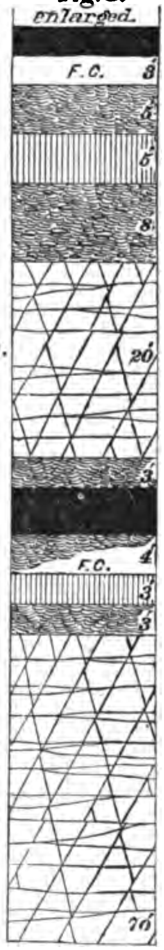
Freeport upper coal, ...	Freeport group, 135′
Freeport upper limestone, ...	
Freeport upper sandstone, ...	
Freeport lower coal, ...	
Freeport lower limestone, ...	
Freeport lower sandstone, ...	

Kittanning upper coal, ...	Kittanning group, 120′
Johnstown cement limestone, . . .	
Kittanning middle coal, ...	
Kittanning lower coal, ...	
Ferriferous limestone and ore, . .	Clarion group, 80′
Clarion upper coal, ...	
Clarion lower coal, ...	
Brookville coal, ...	

Freeport Group.

§ 75. When all its members are present, the Freeport group exhibits the succession shown on an enlarged scale by Fig. 3. There often changes in the various intervals, but a thickening or thinning in any one member is usually partly or wholly compensated by correlative changes in the adjacent intervals. The left hand column of figures shows the maximum and minimum thickness of each stratum; the right hand column the average measurements of the group.

Fig. 3.



§ 76. *Section of Freeport Group.*

2′ to 5′	Freeport upper coal, ...	3′
3′	Fireclay, ...	3′
0′ to 10′	Shale, sometimes fireclay, . .	5′
2′ to 5′	Freeport upper limestone, . .	5′
2′ to 8′	Shale, with ore balls, ...	8′
20′	Freeport upper sandstone, . .	20′
0′ to 3′	Shale, ...	3′
1′ to 7′	Freeport lower coal, ...	5′
1′ to 5′	Fireclay and shale, ...	4′
0′ to 4′	Freeport lower limestone, . .	3′
3′ to 5′	Shale, ...	3′
40′ to 80′	Freeport lower sandstone, . .	70′

I have never found all the members of this group present at any one locality in Clarion county; one, two, or even three are wanting in most of the sections compiled in this district, but this is partially owing to deficient exposures. Fig. 3 has been drawn on a scale five times as large as the other section cuts of this report. This was done to insure clearness.

§ 77. The total thickness of the Freeport group varies from one hundred and twenty to one hundred and forty-five feet, but it is occasionally diminished to less than one hundred feet, by local thinning away of the Freeport lower sandstone. At the Bostonia coal mines in Armstrong county two miles from New Bethlehem, the whole group measures little over seventy feet. The Freeport lower sandstone is there replaced by less than twenty feet of shale, and the Freeport upper sandstone is quite thin. Such remarkable local variations are rare, and do not occur in Clarion county.

Freeport Upper Coal.

§ 78. By reference to the geological map it will be seen that this bed is found only in the summits of Madison, Toby, Perry, Porter and Red Bank townships, having been removed by erosion from all the remaining townships of the county.

§ 79. In Madison and Toby townships this bed ranges from two feet six inches to four feet three inches, but is often entirely cut out by horse-backs and other irregularities, probably due to ancient coal measure streams. It has been mined quite largely by Red Bank and Sarah furnaces. All the coal used by these stacks was taken from the summits overlooking the river above Brady's Bend, and was coked in open hives at the pit-mouth. The resulting coke contained much sulphur and ash, and was full of flaws. The coal is too sulphury and slaty to yield good coke unless extraordinary care be taken to remove the impurities which might be effected by crushing and washing the coal preparatory to coking. An average sample of the Red Bank furnace coke, taken from the centre of a hive that had been exposed to the weather for several years, yielded by analysis (A. S. McCreath):

Water,	.230
Volatile matter,	1.106
Fixed carbon,	88.360
Sulphur,	1.076
Ash, (reddish gray,)	9.228
	100.000

The above analysis shows this coke to be of better quality than its appearance indicates.

§ 80. In Porter township the Freeport Upper coal is an excellent bed, remarkably free from sulphur, and unusually thick. It was used in a raw state many years ago by the St. Charles Furnace, yielding pig metal nearly as soft as charcoal iron. The stack ran easily on this fuel, showing little or no tendency to clog up, and the production was as large as when charcoal was used. Remarkably good results were obtained by mixing with the raw coal, coke made from the Freeport lower coal. In this township the bed measures from four feet to four feet nine inches of workable coal, contains no slate partings, but is full of minute laminæ of mineral charcoal; does not lose its shape in burning, and swells very little, being in these respects very similar to the celebrated Sharon Block coal of Mercer county. These properties enabled the furnacemen to use it in a raw state in the St. Charles furnace, which was a charcoal stack thirty feet high. I do not think it would bear the burden of the charge in a much higher stack.

At Mr. Goheen's bank, near the St. Charles Furnace property this bed measures (Fig. 4):

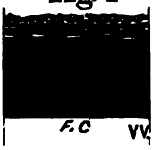
Freeport upper coal.

Shale roof.

Coal,—somewhat slaty,	9″	4′ 9″
Coal,—good,	4′ 0″	

Fireclay floor.

Fig.4



§ 81. In Red Bank township this bed usually measures about four feet. It is more sulphurous and slaty than in Porter township, but is nevertheless a very fair coal. Its available area is quite limited.

The following analysis shows the character of this coal at Mr. Goheen's bank, in Porter township:

	No. 13.
Water,	1.520
Volatile matter,	35.320
Fixed carbon,	54.448
Sulphur,	.672
Ash, (cream,)	8.040
	100.000
Coke, per cent.,	63.16
Fuel ratio,	1:1.54

"Average sample, exposed in dump for some time. Probably outcrop coal. Lustre deep black, more or less stained with iron oxide. Bands of slaty coal throughout specimen. Seems in main free from pyrites."

Freeport Upper Limestone.

§ 82. As this limestone lies only from three to ten feet beneath the Freeport Upper coal, it may be considered as co-extensive with that coal bed. At many localities it is difficult, often impossible, to find any trace of this stratum; indeed, its exposures are very rare,—so rare that I have been led to suspect it is often absent.

It ranges from two to five feet in thickness, is of a dove to gray color, with a somewhat conchoidal fracture.

In Perry township it has been quarried quite extensively in lieu of the Ferriferous limestone.

The following analyses, made by Mr. McCreath, show its usual composition:

	No. 27.	*No. 34.*
Carbonate of lime,	93.803	82.678
Carbonate of magnesia,	2.270	8.248
Oxide of iron and alumina,	.765	1.365
Phosphorus,	.008	.022
Insoluble residue,	1.800	5.320

No. 27 was a specimen from New Athens, in Madison township. No. 34 was taken from Reichert's quarry, in Perry township.

This limestone is exposed at several places in Madison township, but in Porter and Red Bank townships it is rarely seen.

Freeport Upper Ore.

§ 83. This ore bed lies from five to fifteen feet below the Freeport Upper limestone. It occurs either as ball-ore distributed through several feet of fireclay or fireclay shale, or as a solid band of plate-ore from six inches to two feet thick, but sometimes both the plate and ball-ore are present.

§ 84. In Porter, Red Bank and Toby townships it is rarely seen, and is comparatively valueless; but in Madison township it is often locally present, while in Perry township it occurs in *all* the knobs high enough to contain it. It has been mined quite extensively from the high land near West Freedom, and most of the available ore has already been extracted.

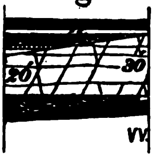
Freeport Upper Sandstone.

§ 85. The horizon of this rock is often occupied by shale. Where the sandstone is present in force we usually find the arrangement shown by Fig 5.

Freeport Upper sandstone section.

Freeport upper coal, ...	4′
Fireclay, ...	3′
Shale, with Freeport upper limestone,	0′ to 10′
Freeport upper sandstone, ...	20′ to 30′
Shale, ...	3′ to 10′
Freeport lower coal, ...	3′ to 6′

Fig:5.



Though this rock is often wanting, when present it is usually quite hard and massive, outcropping in rough escarpments like those seen near Mr. Goheen's coal banks, in Porter township.

Freeport Lower Coal.

§ 86. In Porter and Red Bank townships this is a magnificent bed of coal, but unfortunately its available area is not large. It is entirely without any slate partings, contains very little sulphur, and obtains a thickness of from six to seven feet. Its upper layers are usually inferior to the lower part of the bed, but the whole seam furnishes coal of excellent quality.

§ 87. It is extensively wrought by the Fairmount Coal Company, at their No. 1 opening, where it measures from five feet and a half to six feet and six inches. The company sell most of this coal for gas making, to which use it is admirably adapted, as will be at once seen from an examination of the analyses given in the table below. The slack coal is utilized by coking. As it is often mixed with much slate and fireclay from the roof and floor of the mine, it is washed by a "Stutz" machine before being introduced into the coking ovens. Two analyses made by Mr. McCreath show the effect of this operation on the slack coal; they will be found in the description of Red Bank township.

The resulting coke shows by analyses, (McCreath):

Water,	.030	.210
Volatile matter,	.623	.738
Fixed carbon,	85.777	82.904
Sulphur,	3.107	1.360
Ash, (red) (reddish-grey,)	11.463	14.788
	100.000	100.000

"Lustre, silvery; structure rather dense; numerous lenticular masses of slate especially in centre of specimens."

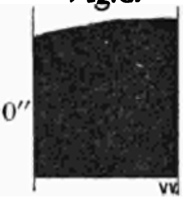
§ 88. The largest intact area of this coal bed is found on the St. Charles furnace property and adjoining lands to the north. A railroad three or four miles long with a grade of one hundred and twenty five or fifty feet per mile would give access to these lands, or the grade might be somewhat reduced and inclined planes built from the pit-mouths to the railroad.

§ 89. At the Wilkin's opening near the St. Charles furnace lands this coal measures, (Fig. 6):

Freeport Lower Coal.

Coal; in roof, ...	1′ 0″	8′ 0″
Coal; rather poor, ...	1′ 0″	
Coal; good, ...	6′ 0″	
Fireclay floor.		

Fig. 6.



Coke made from this bed was used by the St. Charles furnace in conjunction with raw coal from the Freeport Upper coal, and is said to have very materially increased the run of iron.

The following table of analyses shows the character of this Lower Freeport coal at different localities in the southern townships of Clarion county.

§ 90. *Analyses of the Freeport Lower Coal.*

	11	12	17	18	25
Water, ...	1.320	1.170	1.850	1.640	4.775
Volatile matter, ...	40.565	39.155	38.510	37.115	35.118
Fixed carbon, ...	53.980	51.388	54.669	56.357	53.632
Sulphur, ...	1.490	2.067	1.046	1.163	1.095
Ash, ...	2.645	6.220	3.925	3.725	5.380
	100.000	100.000	100.000	100.000	100.000
Coke per cent., ...	58.115	59.675	59.640	61.245	60.107
Color of ash, ...	red-grey.	grey.	red-grey.	cream.	cream.
Fuel ratio, ...	1 : 1.33	1 : 1.31	1 : 1.42	1 : 1.51	1 : 1.52

No. 11. Fairmount Coal Company, bank No. 1, Red Bank township.

No. 12. Goheen's bank, Porter township.

No. 17. McNutt's bank, Porter township.

No. 18. Wilkin's or McClure's bank, Porter township.

No. 25. Murphy's bank, Madison township.

These analyses need no comment, they bespeak for themselves the excellent quality of this coal.

In Madison, Toby and Perry townships this coal is found only in the highest knobs; is usually of inferior quality and quite thin.

Freeport Lower Limestone.

§ 91. This stratum is usually from two to eight feet beneath the Freeport Lower coal. In is by no means a persistent member of the coal series, and even when present is rarely exposed.

It is often called the "flag lime" from its division into plates or flags by lines of stratification from one to three inches apart. These plates are always rough on both their inferior and superior surfaces, and are readily separated from each other.

The thickness of the bed is extremely variable, ranging from one to six feet. As it yields an inferior lime it is rarely quarried. A specimen taken from its outcrop on the road running southeast from Reimersburg, yielded by analysis (McCreath):

	24.
Carbonate of lime, ...	82.000
Carbonate of magnesia, ...	6.311
Oxide of iron and alumina, ...	2.736
Phosphorus, ...	.015
Insoluble residue, ...	7.940

Freeport Lower Sandstone.

§ 92. At Brady's Bend and throughout the eastern part of the county, this is a hard massive sometimes coarse grained sandstone, jutting out in abrupt escarpments along the steeper hillsides. It is gorgeously exposed in a vertical cliff on the Armstrong side of the Allegheny river at Brady's Bend, where it shows a most extraordinary thickness, which cannot be wholly attributed to it alone, but to its union with the underlying sandstone that here occupies the horizon usually filled by shales of the Kittanning group. It is possible however that there is here a *boni fide* thickening downwards of the Freeport Lower sandstone. If this be true, then an extensive coal measure erosion of the Kittanning shales at this point must have preceded its deposition.

§ 93. In Toby, Porter and Red Bank townships much of this rock is replaced by shale in which small worthless sporadic coal seams are occasionally found. These are possible the "Eichenhaur and Currie" local coals of Q and V.

The Freeport lower sandstone caps many of the summits in Piney, Monroe and Limestone townships, and its lowermost layers just touch the high land near Edenburg.

The Kittanning Group.

§ 94. This group embraces from one hundred and ten to one hundred and thirty feet of measures which usually contain the succession shown on an enlarged scale by Fig. 7.

§ 95. *Section of the Kittanning Group.*

1′ to 3′	Kittanning upper coal,	2′
0′ to 4′	Fireclay or shale,	2′
0′ to 6′	Johnstown cement bed,	3′
40′ to 50′	Shale ; sometimes contains sandstone,	45′
1′ to 3′	Kittanning middle coal,	2′
2′ to 4′	Fireclay,	3′
35′ to 40′	Shale,	35′
2′ to 5′	Kittanning lower coal,	4′
2′ to 6′	Fireclay,	5′
12′ to 28′	Sandy shale ore balls near bottom,	20′
½′ to 2′	*Ore—carbonate of iron,*	*1′*
4′ to 15′	*Ferriferous limestone,*	*10′*

§ 96. The Ferriferous limestone and its overlying ore belong to the Clarion group, but are added to the above section to show the relationship of the Kittanning coals to the underlying measures.

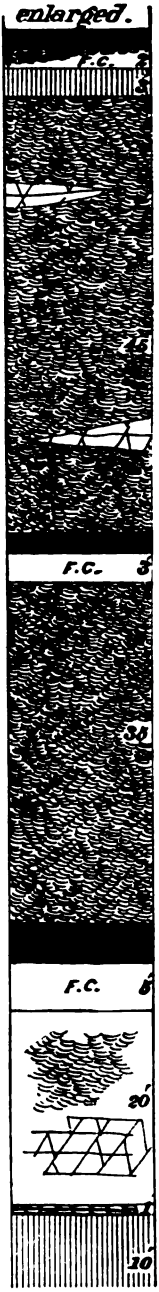
§ 97. The development of this group as a coal series is rather obscure in Clarion county. Its three members are nearly always present but all of them can seldom be detected at any one locality. This is owing to the fact that the Upper and Middle beds are rarely more than one and a half to two feet thick. On careful topographical examination their position can sometimes be recognized by slight terraces or swampy ground.

Kittanning Upper Coal.

§ 98. I have never seen this coal of workable size or quality in Clarion county. It has been repeatedly opened at several places in Red Bank township, and has been prospected upon in many other townships, but always with negative results.

Fig. 7.

enlarged.



Kittanning Upper coal bed, ...
Johnstown cement bed, ...
Kittanning Middle coal bed, ...
Kittanning Lower coal bed, ...
Ferriferous sandstone, ...
Buhrstone iron ore bed, ...
Ferriferous limestone, ...

Its quality is often very good when thin, but when of workable size it is,—so far as we now know,—a very inferior bed.

At the Bostonia mines near New Bethlehem in Armstrong county this bed consists of an upper bench of cannel coal averaging seven feet in thickness, with a subjacent two foot bench of bituminous coal. I have found no cannel coal at this horizon in Clarion county.

The horizon of this coal is, however, *par excellence* the cannel horizon of the Lower Productive coal measures. The celebrated Darlington cannel, the Murrinsville and North Washington cannel coals of Butler county (Report V), the Bostonia cannel, and the cannel coal mined at many other localities in these northwestern counties, all apparently occur at this place in the coal measures. But though this bed is the *main cannel horizon*, the bed is *usually* an ordinary bituminous seam, its change to cannel being purely local and of sporadic nature.

The lower two-foot bench of the Bostonia mines has been found and opened at Fairmount, by Capt. Brinker of the Fairmount Coal Company, but no trace of the upper (cannel) bench was discovered. It therefore cannot be co-extensive with the bituminous bench.

§ 100. The Kittanning Upper coal, thin and poor, is often seen out-cropping along the roadsides in Limestone, Toby, Madison and Perry townships. It can be identified by its height of one hundred and ten to one hundred and thirty feet above the Ferriferous limestone, and by its proximity to the overlying Freeport Lower sandstone.

Johnstown Cement Limestone.

§ 101. This stratum takes its name from the locality where it is best known, viz: Johnstown Cambria county, Pennsylvania, where it had always been erroneously identified with the Ferriferous limestone until Mr. Platt in Report HHH proved that its place in the coal measures is far above that of the Ferriferous.

I have seen this stratum exposed at only one locality in Clarion county. This exposure is situated on Middle run (though far above stream level), 1,000 feet north from the Fairmount Coal Company's opening on the Freeport Lower coal. Vague reports assign it a thickness of six feet, but from the character of the outcrop I do not think that its entire measurement will exceed three feet.

It is an extremely ferruginous limestone of brownish-grey color, rather hard, and breaks in blocks of irregular shape.

§ 102. The following analyses made by Mr. McCreath, contrast its character at Argyle, in Butler county and at Fairmount, this county.

	6.	*7.*
Carbonate of lime,	20.803	25.089
Carbonate of magnesia,	4.964	6.008
Carbonate of iron,	47.642	37.596
Sesquioxide of iron,	1.500	1.571
Alumina,	5.390	4.851
Sulphur,	.133	.083
Phosphorus,	.508	.474
Insoluble residue,	15.920	20.100
Metallic iron,	24.050	19.250

No. 6 is a sample taken from an opening made by Maj. Mobly, at Argyle, Butler county.

No. 7 is the bed exposed at Fairmount.

The striking agreement of these two analyses places the identity of the two beds beyond doubt. The specimen from Argyle is rather more ferruginous than that obtained at Fairmount. It might be termed a self-fluxing ore.

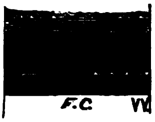
Kittanning Middle Coal.

§ 103. This is a somewhat better coal than the Kittanning Upper bed. It is generally too thin to mine, but is opened at a few banks in the southern row of townships. At Mr. Somerville's bank, in Toby township, it shows this structure, Fig. 8:

Kittanning middle coal:

Shale roof.		
Slaty coal,	7″	3′ 8′
Coal,	2′ 0″	
Slate,	1″	
Coal (about),	1′ 0″	
Fireclay floor.		

Fig 8.



It lies about forty feet above the Kittanning lower coal and forty-five feet more or less, below the Kittanning Upper bed. Average samples of this coal, taken from the Somerville bank and the abandoned opening at Fairmount, yielded on analysis by Mr. McCreath:

§ 104. *Analyses of the Kittanning Middle Coal.*

	16.	*23.*
Water,	4.765	1.410
Volatile matter,	35.675	36.900
Fixed carbon,	54.037	46.917
Sulphur,	.913	1.583
Ash,	4.610	13.190
	100.000	100.000
Coke, per cent.,	59.560	61.690
Color of ash,	cream.	grey, red tinge.
Fuel ratio,	1:1.51	1:1.27

No. 16, Fairmount Coal Company, old opening,—outcrop coal. "Yields an inferior coke."

No. 23, Somerville's bank, Toby township. "Numerous bands of greyish-black ashy coal throughout specimens."

The Fairmount opening yields very fair coal, but the bed is too thin for profitable mining. It is possible that some areas may yet be found in which this bed is of workable size, but much prospecting has already been done at its horizon yielding as yet only negative results.

Kittanning Lower Coal.

§ 105. Farmington, Paint, and Elk are the only townships of Clarion county in which this coal is not found. In that part of the county lying north of the townships bordering on Red Bank creek, the Kittanning Lower coal lies very close to the Ferriferous limestone.

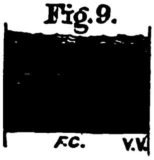
At Sligo it is from fifteen to twenty feet above the limestone; in Beaver township, about twenty feet above that stratum; and in Highland and Knox it is sometimes within ten feet of the limestone ore; while at Red Bank it is forty and at Fairmount thirty-five feet above the top of the Ferriferous.

§ 106. At Catfish the bed measures, Fig. 9:

Kittanning lower coal (a):

Shale roof, seen,		(25′)
Slate and coal,	10 ″	4′ 6″
Coal,	10 ″	
Pyrite,	½″	
Coal,	4 ″	
Soft, bony parting,	1 ″	
Coal,	1′ 10 ″	
Soft parting,	½″	
Coal,	6 ″	
Fireclay floor.		

Fig. 9.



In this vicinity it is highly prized as a steam coal, for which purpose it is also mined at Fairmount. Capt. Brinker, of the Fairmount Coal Company, has lately made some experiments with a view to utilizing the slack by coking. The following analysis (No. 5) was made from a sample of this coke; beside it is an analysis (No. 32) of coke made from the same coal at Sligo. The large percentage of sulphur might be greatly decreased by washing the slack prior to coking.

	5.	*32.*
Water,	.020	2.090
Volatile matter,	.510	2.826
Fixed carbon,	84.588	84.248
Sulphur,	2.672	1.764
Ash,	12.210	9.072
	100.000	100.000
Color of ash,	reddish brown.	reddish grey.
Phosphorus,	.012	

§ 107. At the opening worked by the Fairmount Coal Company the bed shows the structure of Fig. 10. It here lies about thirty feet above the level of Red Bank creek.

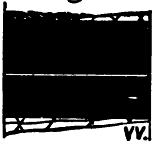
Kittanning lower coal (*b*):

Hard shale and sandstone roof.

Slaty coal,	4″	4′ 11″
Coal,	2′ 4″	
Bone,	2″	
Coal,	1′ 0″	
Sulphur band,	1″	
Coal,	1′ 0″	

Sandstone floor.

Fig. 10.



Going north the bed decreases in size, so that in the northern townships it rarely exceeds three feet while its average thickness is about two feet and eight inches. At the openings worked by the Sligo Branch Coal Company near Reimersburg, the bed is three feet and a half thick with only one thin parting near the middle of the coal, thus, Fig. 11:

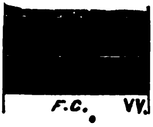
§ 108. *Kittanning Lower Coal* (*c*).

Black slate roof.

Coal,	1′ 8″	3′ 6″
Parting,	1″	
Coal,	1′ 9″	

Fireclay floor.

Fig. 11.



The bed is rather variable in this vicinity rapidly changing from three feet three inches to four feet and six inches.

§ 109. The Kittanning Lower coal has an available workable area far exceeding in extent that of any other bed in this county. In Red Bank, Porter, Madison, Piney, Toby, Monroe and Limestone townships broad tracts of it remain in an almost undisturbed state. The country banks rarely penetrate more than two or three hundred feet into the hill sides so that when this coal has a thick covering they do not touch the main body of the bed.

The accompanying table of analyses (page 48) made by Mr. McCreath, shows the average quality of the bed at different localities in Clarion county. They all show a large percentage of volatile matter, but as a drawback to this the amount of sulphur is frequently so great as to materially impair its quality. It is always a strong steam coal.

§ *110. Analyses of the Kittanning Lower Coal.*

.	*8.*	*9.*	*10.*	*15.*	*22.*	*30.*	*33.*	*36.*	*37.*
Water, ...	.850	.930	1.050	1.020	1.370	1.470	2.070	1.750	2.060
Volatile matter,	39.655	41.000	38.955	40.425	41.575	41.355	35.695	36.440	38.075
Fixed carbon, .	49.787	48.571	41.357	47.511	49.816	49.930	55.275	55.438	56.782
Sulphur, ...	1.548	1.534	5.773	3.789	2.824	2.070	.830	1.072	.818
Ash, ...	8.160	7.965	12.865	7.255	4.415	5.175	6.130	5.300	2.265
	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Coke, per cent., .	59.495	58.07	59.995	58.555	57.055	57.175	62.235	61.810	59.865
Color of ash, . .	red-gray.	white.	pink.	red-gray.	cream.	gray, red tinge.	gray, red tinge.	red-gray.	cream.
Fuel ratio, . . .	1 : 1.25	1 : 1.18	1 : 1.06	1 : 1.17	1 : 1.19	1 : 1.21	1 : 1.55	1 : 1.52	1 : 1.49

No. 8. Fairmount Bank, No. 4, upper bench.
No. 9. Fairmount Bank, No. 4, middle bench.
No. 10. Fairmount Bank, No. 4, lower bench.
No. 15. Songers's Mine, Red Bank township.
No. 22. Sligo Branch Coal Company, Toby township.
No. 30. Fox Bank, Piney township.
No. 33. McCall's Bank, Perry township.
No. 36. Sloan Bank, Limestone township.
No. 37. Clarion Coal Company, Clarion township.

The bed is very favorably situated for mining on Town run and near Shannondale in Red Bank township where it is tolerably thick and of fair quality, with very little slate. It is easily accessible from the Low Grade railroad, and though it has a rather steep dip southwest by west, it lies for several miles at a nearly uniform elevation above the stream.

The Clarion Group.

§ 111. In the southern part of the county and in Armstrong county, as well as in southern Butler this group consists of the Ferriferous limestone and two underlying coal beds ; but in northern Butler, northern Clarion and Venango county it contains three coal beds. In Report V on northern Butler this peculiarity of the group was described and an explanation (somewhat hypothetical) of it hazarded from rather meagre data. Subsequent study of the Clarion county coals and of this group in Venango county (while preparing the geological coloring of the Venango county map) has furnished a series of sections which corroborate my former conclusions.

§ 112. The accompanying illustration,—Plate I,—shows a series of sections taken along a line running northeastwardly from Martinsburg in Butler county to Edenburg in Clarion county with one or two additional sections north and south of that line. The splitting of the Clarion coal into two beds would probably be shown better by sections along a line running northwardly from Martinsburg to Scrubgrass, but in the absence of such a series, those obtained in Clarion county have been used.

§ 114. The Brookville coal which ordinarily lies from thirty to fifty feet beneath the Clarion lower coal is not shown on the plate. When this coal is present north of the split the group consists of the succession shown by Fig. 12. This figure was drawn on an enlarged scale to clearly show the different members of the group.

§ *113. Description of Plate I.*

	A.	*B.*	*C.*	*D.*	*E.*	*F.*	*G.*	*H.*
Ferriferous limestone, ...	5′	4′	6′	15′	12′	7′	8′	10′
Shale, ...	35 to 25′	18′	16′	15′	10′	1′ 6′ } 7′	4′	0′
Clarion upper (Scrubgrass,) coal, .	. . . . .	3′	3′	1½′	2′	1′	1′ 8″	2′
Shale or slate, ...	. . . . .	1′	7′	15′	18′	25′	. . . .	25′
Clarion lower coal, ...	4′	3′	4′	3½′	4′	1½′	. . . .	3′
Total, excluding limestone, . . .	29′	25′	30′	35′	34′	34½′	. . . .	30′

Section *A* shows the normal arrangement of the group south of the split.

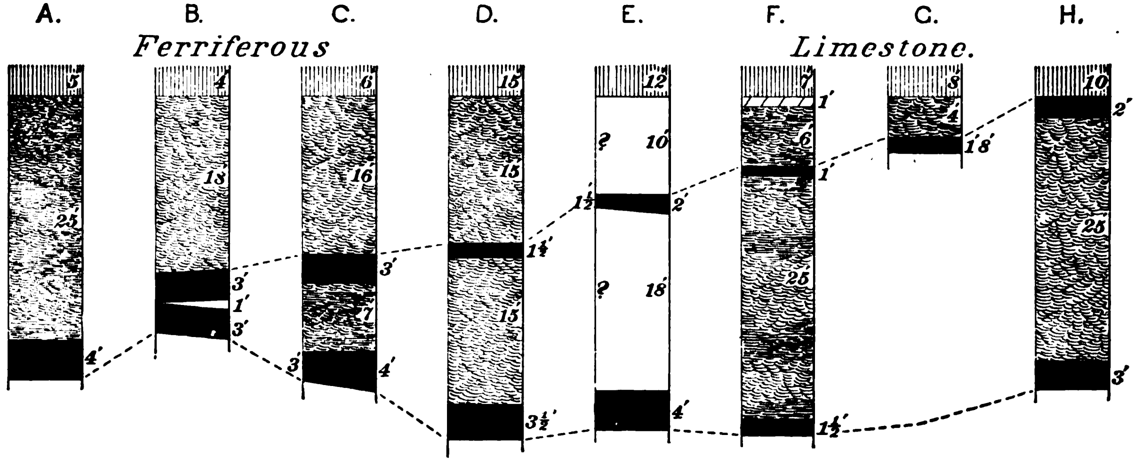
Section *H* shows the usual arrangement of the group northwest of the split.

Sections *B* to *F* are located along a line running northeastwardly from Martinsburg, in Butler county, to Edenburg, in Clarion county, to wit: *B*, at Martinsburg; *C*, Bear Creek; *D*, at Parker; *E*, at West Freedom; and *F*, at Edenburg.

Section *G* was compiled in Venango county two miles northeast of Emlenton, and is introduced to show the near approach of the Clarion upper coal to the Ferriferous limestone.

Diagram showing the Clarion Coal split into two Beds.

by H. Martyn Chance.

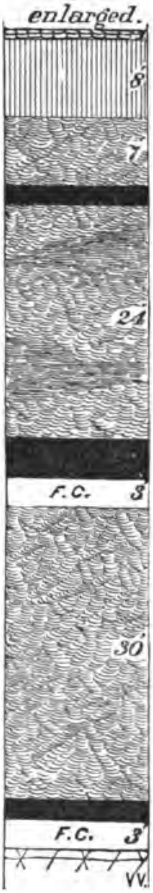


G.B.H.

§ *115. Northern Section of Clarion Group.*

Ore,—carbonate of iron,	1′
Ferriferous limestone,	8′
Shale,—variable,	7′
Clarion Upper (Scrubgrass,) coal,	2′
Slaty shale,	24′
Clarion Lower coal,	4′
Fireclay,	3′
Shale,	30′
Brookville coal,	2′
Fireclay,	3′
Homewood sandstone,	top.

Fig. 12. *enlarged.*



While the above figure shows the usual arrangement of this series north of the split Clarion coal, it does not express the universal structure of the group, for this is not constant. At many localities in northern Clarion and northern Butler,—as for instance on Wolf creek, V, page 129,—the Brookville coal finds no place in the series, being cut out by the Homewood sandstone, which lying far above its normal horizon occupies the horizon properly belonging to the Brookville coal and its overlying shales.* When this structure obtains the Clarion Upper and Lower coals are usually both present.

Additional sections showing the Clarion coal split into two beds will be found by reference to Figs. 64 and 73, which have been drawn on the same scale as Figs. 12 and 13 to facilitate comparison with the sections of Plate I. It will be readily seen that Fig. 64 will fit between sections *B* and *C* of Plate I; its geographical location alone indicates its position. The two beds probably unite a short distance south of this section. The section shown by Fig. 73 falls between section *E* and *F* on the plate. The Brookville coal was not seen near the place of either section 64 or 73, though it is probably present at both localities.

---

* These shales and the Clarion sandstone are identical.

South from the junction or union of the two benches of the Clarion coal the normal arrangement of the group is similar to that shown by Fig. 13.

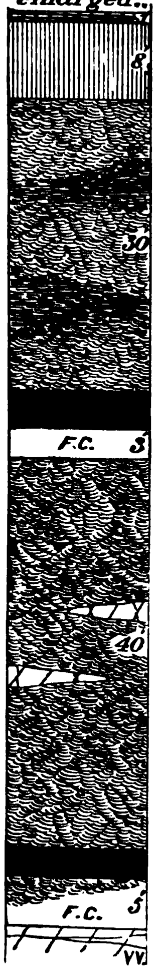
§ *116. Southern Section of the Clarion Group.*

Ore; carbonate of iron,	1′
Ferriferous limestone,	8′
Slaty shale,	30′
Clarion (upper and lower) coal,	4′
Fireclay,	3′
Shale; containing Clarion sandstone,	40′
Brookville coal,	3′
Fireclay and shale,	5′
Homewood sandstone,	top

This structure is also modified at times by a rise in the Homewood sandstone, so that the Clarion coal lies but a few feet above that stratum, thus leaving this coal, (the Clarion coal proper,) as the sole representative of the group.

The Clarion group, or a portion of it, is found in every township in Clarion county; in the northern parts it is the Summit series.

Fig. 13. enlarged..



The Ferriferous Limestone and Ore.

§ 117. As the "limestone" or "buhrstone ore" is always intimately associated with the Ferriferous limestone, and as their outcrops are practically co-extensive, they are best described together. A separate and more minute description of the ore will be found in the chapter describing the charcoal iron furnaces.

The Ferriferous limestone in Clarion county has an average thickness of eight feet; but in the western townships, as it approaches its area of best development in Butler and Armstrong counties, it sometimes attains a thickness of fifteen feet; but in the northern, eastern and southern townships it rarely exceeds six feet.

When thick its planes of stratification are usually two or three inches apart, giving it a flaggy character. The bed plates present numerous depressions and elevations somewhat resembling a "cobblestone" pavement. They are never smooth. The rock is much more massive when thin, with layers from one to two feet thick; is harder and usually of darker color.

§ 118. The stone varies somewhat in color, usually being of a dirty gray tinge, but sometimes is quite dark, even nearly black and again may approach a bluish steel color. Though characteristically fossiliferous its fossils are seldom visible in the body of the rock. This is because the individual shells, crinoid stems, etc., are so firmly united together in the body of the rock that they fracture with it in any direction. But the fossils are sometimes beautifully weathered out on surfaces of the rock exposed to ærial action; because the fossils are more or less crystalline in structure, and resist the solvent action of water charged with carbonic acid, whereas the amorphous calcareous matter in which they are imbedded is much more soluble.

§ 119. In some parts of the county the Ferriferous limestone is absent over large areas in which the hills are high enough to catch it. The blue line showing its outcrop on the map, has been omitted from those parts of the county in which it is *known* to be absent.

This blue line represents more than four hundred and fifty linear miles of actual outcrop within the county limits.

§ 120. The overlying ore-bed rests directly upon the limestone, either as a separate layer or gradating downwards by imperceptible shades into the lime-rock, so that it is often difficult to tell where the ore ends and the limestone begins, and *vice versa*. But as a rule there is a distinct line of demarkation between the two; sometimes but not often, the ore-bed is entirely separated from the limestone by a layer of shale from two or three inches to as many feet thick. Again, the ore may exist as balls or kidneys scattered through the overlying shale, or plate-ore and nodules may both be present, the latter overlying the ore band proper.

At exceptional localities the ore bed is two, three or four, sometimes even six feet thick; but this is far more than its average size. It ordinarily measures from six to fourteen inches, with a mean average size of ten inches.

§ 121. The output of any mine or open-working is always increased by a variable amount of ball-ore obtained in the supra-jacent shale.

The following table of analyses made by Mr. McCreath from samples of the Ferriferous limestone, demonstrates without further comment how valuable this stratum was to the old charcoal furnaces, all of which used it as a flux.

§ *122. Analyses of the Ferriferous Limestone.*

	14.	*20.*	*28.*	*35.*
Carbonate of lime, ...	95.232	95.196	95.532	96.428
Carbonate of magnesia, . .	.407	1.265	.930	1.202
Oxide of iron and alumina,	1.310	1.529	1.050	.867
Phosphorus, ...	.061	.081	.070	.023
Insoluble residue, ...	2.190	1.780	1.960	1.110

No. 14. Long Run, in Porter township.
No. 20. Sligo Furnace, Piney township.
No. 28. Hindman's quarry, Clarion township.
No. 35. Barger's quarry, Perry township.

The limestone, used as a furnace flux, would not give as good results as the above analyses indicate, for more or less dirt always becomes mixed with the stone in quarrying and handling it.

Clarion Upper Coal.

§ 123. This is rarely workable, but always furnishes coal of good quality. In northern Clarion county it is usually from four to ten feet beneath the Ferriferous limestone, from which it is separated by soft shale of rather dark color. At Edenburg it is a little over one foot thick, at West Freedom two feet, and at Disler's in Venango county, eighteen inches thick. At the latter locality it has been mined by stripping along with the Ferriferous limestone. South of Edenburg and West Freedom it coalesces with the Clarion lower coal. It is therefore practically absent from the central and southern parts of the county.

Clarion Lower Coal.

§ 124. This, the Clarion coal proper, though rarely a good bed, is mined at many localities in the northern and central portions of the county. In the southern townships it is very thin and poor. It furnishes much better coal in Farmington township than in any other part of the county.

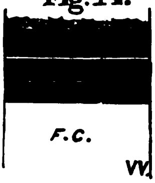
It is found at from twenty to thirty-five feet beneath the Ferriferous limestone. When the Clarion sandstone is present it lies only a few feet above that rock, but as a rule the underlying rocks are the shales that usually occupy the horizon of the Clarion sandstone,—or again, it may lie down close to the Homewood sandstone, when that rock lies above its normal position.

§ 125. In Perry township this coal shows—Fig. 14:

Clarion Lower coal.

Shale roof.		
Coal, ...	11″	3′ 7″
Bone, ...	1″	
Coal, ...	1′ 0″	
Bone, ...	2″	
Coal, ...	1′ 5″	
Fireclay floor, (seen,)	4′ . . .	4′ 0″

Fig. 14.



Brookville Coal.

§ 126. This is an almost worthless bed in Clarion county.

Approaching its area of good development in Jefferson county, it becomes a workable seam in Mill Creek and Limestone, and parts of Clarion, Highland, Paint and possibly Farmington townships, measuring from two and a half to four feet, and is of better quality than in other parts of the county. But at best it is a poor bed, and withal so variable and consequently so unreliable that it need not be looked to for any large supply of coal.

In Brady, Madison, Porter, Perry and Toby, and all the central and western townships, it is little better than a bed of bituminous shale.

§ 127. It is often entirely displaced by the Homewood sandstone, which, elevated by anticlinal rolls or irregularities of original deposition, lies higher than the level of the ancient marsh in which the bituminous matter of this coal bed accumulated.

CHAPTER V.

Rocks underlying the Coal Measures.

§ 128. Sub-carboniferous* rocks properly so-called are found in Clarion county from the bottom of the coal measures down to water level.

§ 129. In all considerations of the sub-coal measure rocks of Clarion county and indeed of nearly all the western counties, the top of these measures is easily and readily fixed by the base of the Clarion group, whether this be the Clarion Lower or Brookville coal bed. In eastern Clarion county the following succession is found beneath the Clarion group, but in the western part of the county the Mauch Chunk shale is not present as *red shale.*

Coal measures, ...	No. XIII.
Conglomerate measures, ...	No. XII.
Mauch Chunk red shale, ...	No. XI.
Pocono, upper or grey, ...	No. X.
Pocono, lower or red, ...	

Pocono No. X.

§ 130. The results of a study of the Susquehanna river exposures in Clinton, Lycoming, Cameron and Elk counties have I think proven that in the western counties the white Pocono sandstone of the east consists of two lithologically distinct sub-divisions, an *upper or grey*, and a *lower or red* member. It is not my province to enter upon a discussion of the oil-rocks; that will be accomplished by Mr. Carll's report I.I.I. on the oil regions; but it seems proper to state that the *red bands* of the oil group,—and consequently the group itself,—seem to correspond to the red rocks of the lower division. The upper or grey Pocono is limited above by the Mauch Chunk red shale and below by the Pocono red bands. A few feet of the upper Pocono comes above stream level along the Clarion river near Cooksburg, but the *lower* or *red Pocono*,—the oil sand group,—is always hidden far beneath water level.

---

* Many objections obtain to an indiscriminate use of the term "sub-carboniferous," which literally is too comprehensive, and as a specific name, gives rise to endless controversies; in that there is at present the greatest possible diversity of opinion as to the extension downward of the true carboniferous; for these reasons this term, though often greatly needed, has been expunged from the following pages.

Mauch Chunk Red Shale, No. XI.

§ 131. The actual existence of the red shale of No. XI in Clarion county was not certainly known until June, 1879, when Mr. W. G. Platt discovered a thin band of it in an exposure on the Low Grade railroad near Patton's station. Knowing that it is present at that locality we are prepared to admit its occurrence in wells drilled at Brookville, Snydersburg, Marienville, (Forest county,) and also as far west as Sligo and Edenburg. The existence of red shale in the Brundred well No. 4 at the last named town we know to a certainty, for this well was carefully watched and measured by Mr. J. H. Carll who preserved sand-pumpings from nearly every stratum pierced by the drill.* The records of these other wells, which will be found scattered through this report, show the existence of a thin red band at a distance below the Ferriferous limestone of from three hundred and twenty-five to four hundred feet. It nearly always occurs at the top, middle, or bottom of an interval of soft measures,—presumably shale or slate,—which is generally of dark color.

---

*The existence of red rock at the same horizon with these Clarion county red bands of No. XI has lately been detected by Mr. Carll in sand-pumpings from the Beaver Falls well in Beaver county. The floor of the derrick of this well is about level with the top of the Homewood sandstone, and the reddish stratum was pierced at a depth of *three hundred and forty feet*, lying at the base of forty feet of soft measures which evidently correspond to the shales immediately beneath the Ohio (Sharon) conglomerate, thus showing a thickness of *three hundred feet* of Conglomerate measures underlaid by soft measures 40 feet, red sandy shale 5 feet. Beneath the red band a layer of *greenish* rock occurs which is probably part of the same stratum. This swells the thickness of No XI at Beaver Falls to at least fifty-five feet. For a record of the Beaver Falls well, see report I.I.I.

Whether this interval or simply the contained red band represents No. XI we cannot positively determine, but it seems most probable that the former is true and that throughout Clarion county a true representative of No. XI is always (or nearly always) present though it may often be lacking in *redness.*

Conglomerate Series, No. XII.

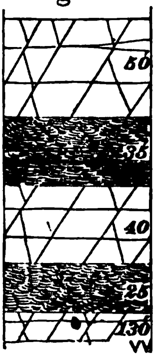
§ 132. As already intimatad the base of this reries is defined by the Mauch Chunk red shale; its top by the Clarion group of coals.

A description of the series as usually found in Clarion county is embodied in the following section, illustrated by Fig. 15.† The sandrocks underlying the Homewood sandstone cannot be arranged in any definite system as they are extremely variable both in number and thickness, but their *total thickness* is very nearly constant.

§ 133. *Conglomerate Series, Fig. 15.*

Homewood sandstone (Tionesta), hard and massive, usually coarse, . .	30′ to 50′
Shaly measures, with an ore bed near middle, sometimes associated with an impure coal bed, ...	35′
Sandstone, massive usually fine grained, (about)	40′
Shale, very variable, is often a source of bog-ore deposits, ...	25′
Sandstone, with one or two thin beds beds of shale, though these are sometimes absent, ...	130′±
Mauch Chunk red shale, in dark, shaly measures, on Red Bank creek (seen),	5′

Fig. 15



---

† This figure fails to show what it was intended to illustrate. By some oversight the 130 feet of sandstone forming nearly half of the Conglomerate series has been merely indicated by the artist, and the *red shale* of No. XI entirely omitted. By imagining the lowest sand rock to extend downwards for about one inch below the bottom of the section, the reader will have a fair conception of the section as originally drawn. This section is duplicated on page plate VI, to which the reader is referred.

§ 134. The above described succession is more usually found than any other arrangement, but it is often hardly possible to definitely fix either the upper or lower limit of the series. In the record of the Columbia oil well, No. 19, the Homewood sandstone is apparently absent, and the downward extension of the Conglomerate measures cannot be accurately determined.* Other instances of similar character are seen in records of the Midland oil well, the James well, and many other wells drilled for oil in Clarion county. In fact, it seems probable that the underlying Pocono strata are often in immediate juxtaposition with the lower layers of the Conglomerate measures; and again, that over certain areas the two formations are separated by the Mauch Chunk red shale, or soft measures equivalent to it. That this latter arrangement can be traced far west of Clarion county is shown by Plate VI, which also shows the horizon of red measures beneath the Conglomerate series to be stratigraphically equivalent to the shales immediately beneath the Sharon conglomerate, a description of which has already been given in Report V. The sections forming this plate are discussed in order below.

§ 135. The Sharon section is taken from a generalized description of the Conglomerate measures given in Chapter 2, Part II, of Report V. It compares well with the Clarion county sections, showing that the Mauch Chunk red shale horizon is probably the same with the shale interval immediately beneath the Sharon or "Ohio" conglomerate. This Sharon or Ohio conglomerate must then be the base of No. XII, the Conglomerate series. In the chapter above referred to the downward limit of the Conglomerate series was not definitely defined, as when that report went to press it did not seem advisable to make any arbitrary division of these measures; but since the completion of my survey of the Beaver and Shenango valleys (1875), I have looked upon the Sharon conglomerate immediately underlying the Sharon coal bed as the basal plate of the Conglomerate series of sandrocks†.

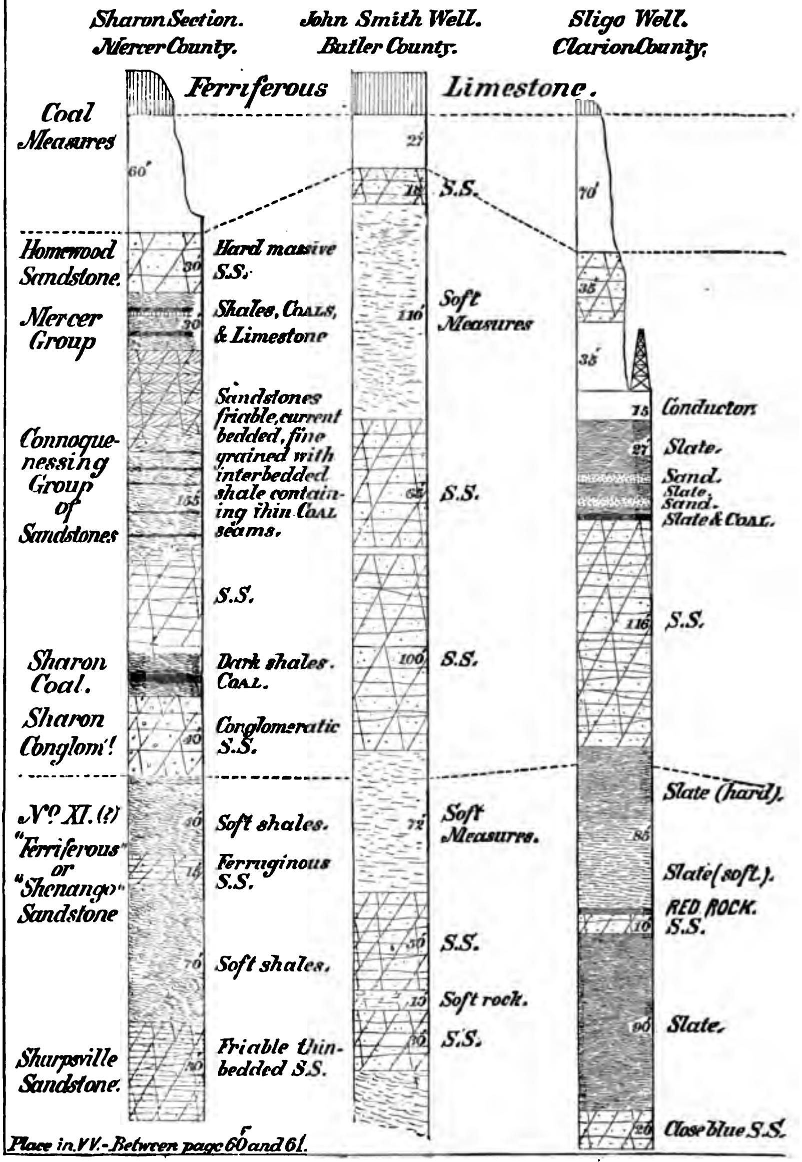
---

* It is probably at a depth of 369 feet in the well.

† See foot-note, page 32, Report V.

Surface Sections and Oil Well Records of the in Clarion County, compared with the

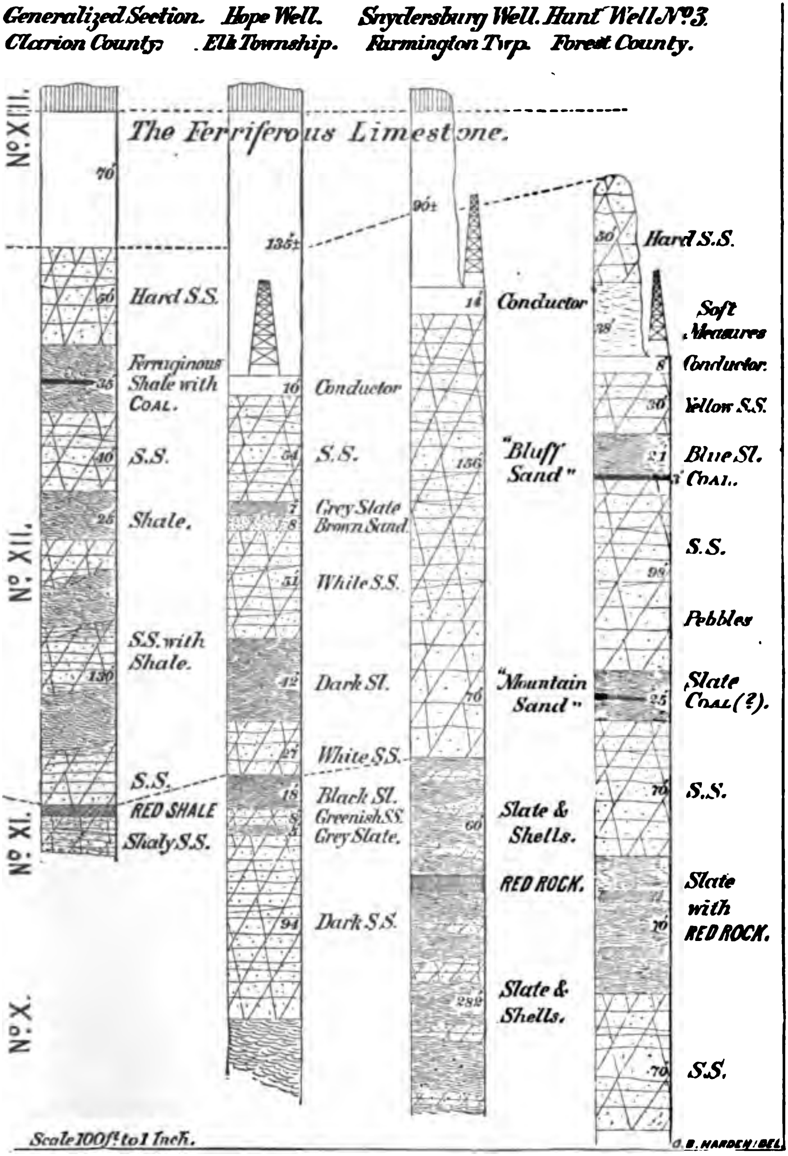
J. P. Lesley. State Geologist



Place in VV.-Between page 60 and 61.

Conglomerate Measures and Mauch Chunk Red Shale surface rocks of Butler and Mercer Counties.

H. Martyn Chance, Ass't. Geologist.



§ 136. *The John Smith well section* is introduced merely as a connecting link between the Mercer and Clarion county sections.

§ 137. *The Sligo well* shows a thin *red band* forming the base of eighty-five feet of soft slate. It is possible that this well is placed somewhat to low beneath the Ferriferous limestone, thus throwing the red-band a little lower than it should appear when compared with the generalized section.

§ 138. *The Hope well record* shows no red rock, but the bottom horizon of the Conglomerate sandrocks is shown by the description, thus:—*White sand, 27′; black slate, 18′; greenish sandstone, 8′;*—the "greenish" sandstone[*] evidently belongs to the sub-conglomerate measures.

§ 139. *The Snydersburg well record* is defective in detail, but nevertheless it exhibits a good generalized representation of the Conglomerate measures, and the distinction between these and the underlying rocks is noted by the driller who gives the name "mountain" sand[†] to the lower sandy bands of the Conglomerate, not dignifying the greyish and "shelly" sand layers below by the name of "*sand*" or sandstone, but calling them "shells," i. e., a hard stratum, generally sandy but finegrained and nearly always of dark color. The *red rock* of No. XI corresponds well with the Sligo red-band.

§ 140. The Mauch Chunk red shale is also shown by the

---

[*] The occurrence of *greenish* or *olive* colored layers of shale in intimate association with red shale, or entirely *replacing* it is one of the most markedly characteristic features of nearly all red shale deposits. The red shales of No. XI, the red sandstones of No. IX [Red Catskill], and the red sandrocks and shales of No. V [Clinton Group] in Eastern Pennsylvania are *full* of olive and greenish-grey layers. And these can often hardly be called *layers*, for in a single stratum the olive-green and red may be so commingled as to give the rock a brecciated appearance.

[†] This distinction is very noticeable in many of the Clarion, Butler and Armstrong county wells where the hole is cased at or near the base of the Conglomerate measures, the sandstones of which being coarser and more porous than the underlying sandy layers contain more or less water all the way down, thus necessitating deep casing. When the base of these loose-grained, whitish sandstones has been passed the driller says that he is "through the mountain sand." The underlying Pocono sandstones or sandy layers are fine grained, greyish and seldom contain an appreciable amount of water.

Hunt and Towler well record. This well is situated near Marienville in Forest county.

§ 141. The basal plate of the Conglomerate measures is often so closely united to the underlying sandrocks of the Pocono formation that it is not easy to say where one ends and the other begins. In many well records we find the driller recording sandstone for five hundred feet or more below the Ferriferous limestone: this is undoubtedly often the result of ignorance, carelessness or indifference, but it sometimes happens that the measures *are* quite sandy for one hundred and fifty feet more or less beneath the base of No. XII. When such conditions prevail, the only means by which the downward extension of the Conglomerate measures can be defined is by a careful preservation and subsequent study *of all the sand-pumpings:* the dividing line between the Conglomerate above and Pocono below is then usually determined with little difficulty by the lithological difference between sands from the respective formations.

The Conglomerate sandrocks always yield lighter colored, coarser, cleaner sand-drillings than the Pocono measures, the sandy layers of which are characteristically greyish, fine-grained, brittle, with more or less clayey cementing material.

§ 142. The division between the Conglomerate series and Mauch Chunk red shale (No. XI Umbral or sub-carboniferous limestone) is necessarily arbitrary, *i. e.*, it has not been proven to be a natural or strongly marked line of demarkation. If the bottom Conglomerate sandrocks were laid down along the shore or as marginal deposits to the bituminous coal basin of western Pennsylvania it seems certain that contemporaneously with their formation finer shale, sandstone, and mayhap limestone was depositing in deeper water over more central areas, which in some parts of the State we may now recognize as the equivalents of the Mauch Chunk (Umbral) red shale and limestone. The attenuated edges of these calcareous and shaly deposits, lapping up over some parts of the already deposited sandstones and conglomerates (of Seral character but Seral-Umbral age,) would now be found interlocked between or in the horizon of sandstones that in this report have been referred to the Conglomerate group.* This view of the structural deposition of the Conglomeratic sandrocks of northwestern Pennsylvania may furnish us an explanation of the apparent occurrence of Umbral linestone (No. XI) in Armstrong county and at Lowellville, Lawrence county at or in the proper horizon of the Connoquenessing group of sandstones.

§ 143. The possibility of extensive erosions of the Pocono and Mauch Chunk strata prior to the deposition of the Conglomerate measures yet remains, but our data are inadequate to a proper discussion of this subject.

§ 144. Economically considered the Conglomerate measures in Clarion county present little of interest or value. Its coals are thin, impure, subject to sudden local variations and are few in number. Those lying in the interval of shale and slate subjacent to the Homewood (Tionesta) sandstone are always more persistent, thicker and purer than any lower beds, in fact the coals underlying this horizon hardly deserve the name; they are little more than seams of bituminous shale.

§ 145. *Mercer coals.*—Coal seams of the Mercer horizon, *i. e.*, beneath the Homewood sandstone, have been worked on Catfish run in Madison township, in Paint township and at North Pine Grove(?) in Farmington township, yielding at these as well as some other now abandoned workings, a very fair non-pyritous coal. The great drawback in working these seams is their irregular and often insignificent thickness.

§ 146. *Mercer Ore-beds.*—In the same horizon with these (Mercer) coal beds several ore-beds have been discovered and worked at a few places. This ore, a nodular carbonate in most part, usually lies disseminated through several feet of bluish shaly slate, but at times is found in several closely approximated but entirely distinct beds, each of which consists of a succession of nodules, or of a true seam continuous as such for a long distance. Where this ore has been opened its horizon embraces from three to eight feet of shaly measures throughout which more or less ore in balls is always found. Another ore horizon occurs at a distance of from twenty to forty feet below the above described bed. In all essential points it is very similar to the upper layer, indeed the two are so like that it is impossible to tell one from the other by a mere inspection of the deposit; but as the *upper bed* lies only a few feet *beneath the Homewood sandstone*, and the *lower bed* is found a short distance *above* one of the (Connoquenessing?) Conglomerate sandstones, their identification should never be difficult.

---

*This same feature is strikingly shown by some of the detailed sections of the Conglomerate in the Anthracite coal regions published in the report of the First Survey, where the red shale of the Umbral (Mauch Chunk) measures is digitated with the lower Conglomerate layers making it impossible to tell where one formation begins and the other ends.

§ 147. These ore-beds lying in the apparent horizon of the Mercer group seem to be a continuation *eastward* of the *Mercer limestones* and ore beds. In view of the fact that the Ferriferous limestone is prolonged eastward to the Allegheny escarpment as an ore bed, that the Freeport Lower limestone is often entirely replaced by ore, and that the Johnstown Cement bed is a true calcareous carbonate ore in Clarion and Butler counties, it does not seem improbable that these two sub-Tionesta ore horizons are really continuous or of synchronous formation with the Mercer limestones.

§ 148. On the Slippery Rock creek in Butler and Lawrence counties, and at Smith's ferry on the Ohio river, oil is found in the lower layers of the Conglomerate series. I have never heard of oil having been found at this horizon in Clarion county.

CHAPTER VI.

TOWNSHIPS SOUTH OF THE CLARION RIVER.

Introduction.

§ 149. The southern townships of Clarion county, twelve in number, are described in the following pages in progressive order from west to east, beginning at the southern tier and progressing northwardly to the Clarion river. The ten townships north of the river are described in Chapter VII, under the same system of succession, thus:

Chapter VI. Townships South of the Clarion.

1. Brady,
2. Madison,
3. Toby,
4. Porter.
5. Red Bank,
6. Perry,
7. Licking,
8. Piney,
9. Monroe,
10. Limestone,
11. Clarion,
12. Mill Creek.

Chapter VII. Townships North of the Clarion.

13. Richland,
14. Salem,
15. Beaver,
16. Ashland,
17. Elk,
18. Paint,
19. Highland,
20. Knox,
21. Washington,
22. Farmington.

§ 150. The *southern* townships are much more bountifully supplied with coal than those of the northern tiers. This is due to the general southerly dip of all the measures, which though experiencing local north dips along the anticlinal flexures, gradually sink lower and lower, until at Fairmount on Red Bank creek the Ferriferous limestone is brought down to water level.

§ 151. In the *northern* townships good coal beds are not common; banks in running order (and therefore accessible) rare, compared to their frequency south of the river. These circumstances necessarily render the detailed reports upon these latter townships rather meagre and to some extent unsatisfactory.

Brady Township.

§ 152. This township is very small. Its limits are defined by the great curve in the Allegheny river known for many years as Brady's Bend.

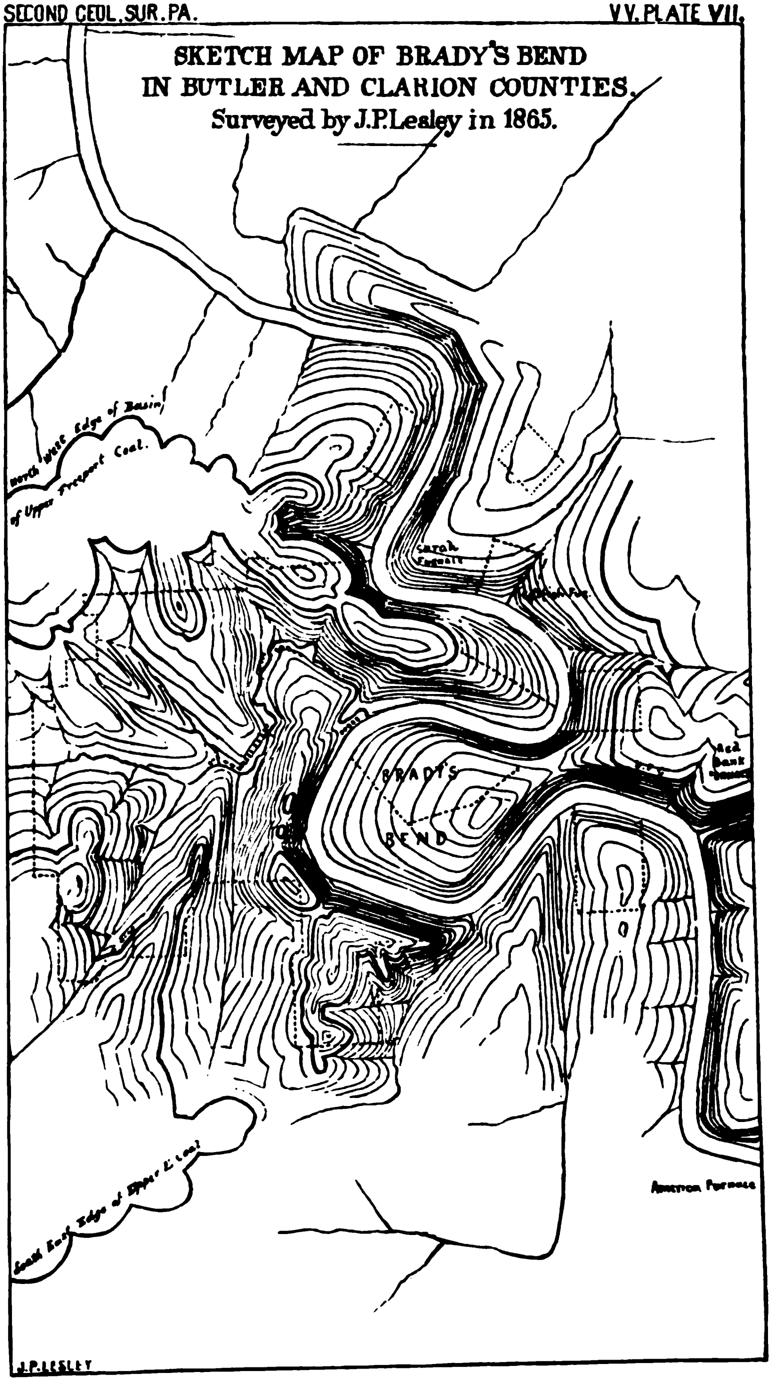
§ 153. *The Brady's Bend synclinal* runs through the centre of the township, entering it at the turn of the river near Catfish and passing out into Armstrong county a short distance west of Phillipsburg. The Kittanning lower coal and the Ferriferous limestone plunge into the trough of this flexure with nearly equal north and south dips. On the crest of the *Brady's Bend anticlinal* at Red Bank, the Ferriferous limestone is sixty feet higher than at Catfish; the distance is about two miles, and the north dip, therefore, about thirty feet per mile, a figure which the southern dip closely approximates.

§ 154. *The Kittanning lower coal* preserves the same general character all around the bend. It is mined for local use at several banks near Phillipsburg, and lately one has been re-opened for working near the site of the abandoned mines below Catfish. This latter is owned by Hartwell & Co. The new plane is located on the site of an old plane formerly owned by the Brady's Bend Coal and Iron Company, and used by them for lowering limestone and ore dug along the face of the bluff. The Kittanning lower coal here lies two hundred and thirty feet above railroad level.

§ 155. *The Ferriferous limestone* and its *ore bed* are easily accessible on the north side of the bend, and at one time were extensively wrought. The limestone is about fifteen feet thick and the ore bed measures from six to ten inches.

SKETCH MAP OF BRADY'S BEND IN BUTLER AND CLARION COUNTIES.

Surveyed by J.P. Lesley in 1865.


North West Edge of Basin of Upper Freeport Coal.
Sarah Furnace
BRADY'S BEND
Red Bank Furnace
American Furnace
South East Edge of Upper F. Coal
J.P. LESLEY

§ 156. The narrowest part of the township is at the neck of the loop, one mile below Catfish. At this point it could be pierced by a tunnel less than three fourths of a mile long. The Allegheny Valley railroad might thus be shortened at least four miles.

§ 157. The section at Brady's Bend on the west side of the Allegheny published in Report V, page 16, is also applicable to this township but as a section at Catfish and one also at Red Bank will be given in the description of Madison township, it is hardly necessary to reproduce that section here.

§ 158. The Kittanning Middle and Upper coal beds are not sufficiently thick for profitable mining in this township; the Freeport Lower coal is quite thin and slaty. The Freeport Upper bed just caps the summit.

Several wells have been drilled near East Brady and Catfish, in search of an extension of the oil rock found on the west side of the Allegheny, but they have all been failures. Experience has shown that *along the borders* of a belt of oil producing rock, the coarse open sand lies in small isolated patches, with much hard close rock intervening. Such is the character of the development at Armstrong run, Queenstown, Whiskey run, Kaylor City, and many other points. It is possible that a pool similar to one of these may yet be found east of the river.

§ 159. Page Plate No. VII shows the principal topographcal features at Brady's Bend. It is reproduced from a sketch map made by Prof. Lesley several years ago to illustrate his report on the Great Western Furnace property. It was afterwards published in the American Philosophical Society's proceedings. The outcrop of the Freeport upper coal is somewhat incorrectly shown on this map, but as the sketch is designed to convey only a *general idea of the topography*, this inaccuracy is of little importance.

A description of the loop made by the Allegheny at this point has already been given in § 64, and other similar loops are mentioned and described in § 9, § 38–45, and in § 47–49, which are illustrated by Fig. 1, and Plate III.

Madison Township.

§ 160. This lies north of Red Bank creek and east of Brady township and the Allegheny river.

§ 161. Along the line of the Brady's Bend synclinal the *Freeport upper coal* is caught in nearly all the higher summits, and even along the crest of the anticlinal it occurs on some of the hilltops, as for instance those near Wildcat furnace. *The Brady's Bend anticlinal* entering the township at Red Bank station runs northeast passing out into Toby township a short distance east of Reimersburg.

§ 162. *The Lawsonham synclinal* is a rather gentle depression or roll entering the township at Lawsonham and passing out at its northeastern corner.

§ 163. *The Kellersburg anticlinal* just touches the southeastern corner of the township near Long Point tunnel. Its north dip is not steep.

§ 164. Two coal seams, the *Freeport Upper* and *Kittanning Lower* beds, are the main reliance for a coal supply in this township. The Freeport upper bed, though not always a clean coal, is usually quite free from sulphur. It has been largely mined near Red Bank and Catfish and also near Reimersburg, but there still remain some few small but comparatively untouched areas.

§ 165. *The Kittanning Lower* bed though extensively mined does not furnish very good coal. It is used almost exclusively as a steam coal, but is too sulphurous to give good results. It underlies the entire township, excepting small areas of erosion along the main streams, presenting an enormous body of easily accessible, and therefore cheaply obtainable coal. Along the Allegheny river and also on Red Bank creek it can be reached at almost any point by an inclined plane from two hundred to two hundred and fifty feet high. *The Freeport Lower coal*, the *Kittanning Upper* and *Middle* beds, and the *Clarion group* of coals are usually very thin and poor and completely overshadowed by the beds described above.

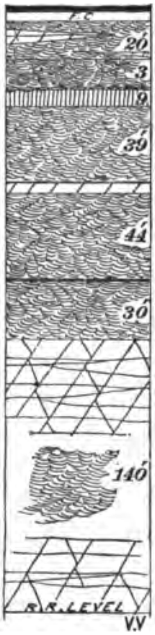
§ 166. The area of the *Ferriferous limestone* and its suprajacent ore-bed is somewhat greater than the extent of the Kittanning Lower coal.

§ 167. At Red Bank furnace the section shown by Fig. 17 was compiled. Most the exposures were noted on the inclined plane, but some were obtained further north along the ore railway. The rocks of the Conglomerate series are not well exposed in this vicinity.

§ *168. Red Bank Section:* Fig. 17.

Kittanning Lower coal, ...	3′
Fireclay, ...	5′
Sandstone and shale, ...	20′
Shale, soft, ...	15′
Ore, variable, ...	1′
Ferriferous limestone, ...	9′
Shale, soft, ...	39′
Bituminous shale, [Clarion coal,] . . .	1′
Sandstone, ...	5′
Shale, ...	44′
Brookville coal, ...	1′
Shale, ...	30′
Sandstone, with some shale to railroad level, ...	140′

17.



The inclined plane is probably situated near or directly upon the crest of the Brady's Bend anticlinal, which raises the coals and limestone seventy feet higher than in the synclinal trough at Catfish.

Though this rise only shows a dip of 30 or 35 feet per mile, the north dip of this axis is often much steeper. The head of the plane is two hundred and forty-five feet above the railroad station, and just reaches the Ferriferous limestone. A narrow gauge railroad, laid with sixteen-pound rails, runs from the plane-head off in opposite directions along the Ferriferous limestone outcrop. One of these branches runs up to the coke pits and coal banks, a distance of nearly two miles.

A large amount of ore has been dug by stripping from the outcrop, and as the hillsides are rather steep, this required the removal of enormous masses of the superincumbent shale.

The ore bed varies from ten inches to two feet in thickness, lying in plates immediately upon the limestone. Some bombshell ore occurs in the soft shales overlying the limestone, and adds a variable increase to the output from the strippings; but the main reliance of these furnace workings has been and ever must be the plate-ore.

§ 169. Much of the ore used by Red Bank furnace was brought from the Lawsonham diggings. This furnace has been out of blast for several years. Nearly 20,000 tons of pig iron are still [October, 1879,] stacked in the furnace yard. An analysis of an average sample of the Red Bank coke gave, (McCreath):

	No. 26.
Water,	.230
Volatile matter,	1.106
Fixed carbon,	88.360
Sulphur,	1.076
Ash, reddish gray,	9.228
	100.000

"No. 26. Coke from Freeport upper coal, Red Bank Furnace. Dull gray; structure rather open; somewhat iridescent; small masses of slate throughout specimens."

This sample was taken from the centre of a hive that had lain exposed to the weather for a long time. All the coke made in this vicinity was burnt in the ordinary open hives or "pits," which were located at the coal banks. It would be interesting to know what improvement might be made in this coke by a preparatory crushing and washing of the coal. Undoubtedly much of the slate and sulphur could thus be removed, and its value correspondingly enhanced.

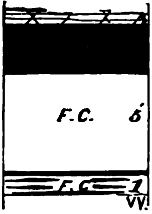
§ 170. *The Freeport Upper coal* is called a "four foot bed," but does not average that thickness. The following measurements, illustrated by Figs. 18 and 19, were made in one of the entries at points only twenty-five feet apart. They show what sharp local variations are occasionally met with in this coal bed.

§ *171. Red Bank Furnace coal bank.*

(*a.*)

Sandstone roof.	
Coal, . . .	2′ 6″
Fireclay, .	5′ 0″
Coal, . . .	0′ 2″
Fireclay, with coal streaks,	1′ 0″

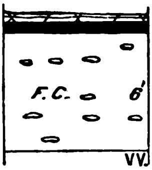
18.



(*b.*)

Sandstone roof.	
Coal, . . .	0′ 6″
Fireclay, with ore balls,	6′ 0″

19.



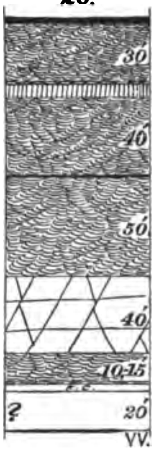
The mines on this bed furnished coal for twenty-four coke hives,—equivalent to about one hundred and fifty ovens.

§ 172. At Red Bank the *Kittanning Lower coal* lies from thirty-five to forty feet above the Ferriferous limestone, and has been opened at several banks, but being much more pyritous and slaty, and also rather thinner than at Catfish, it has been mined very little in this vicinity. It is utterly unfit for the production of an iron-making coke.

§ *173. Lawsonham Section.*

Kittanning lower coal, ...	3′
Shale, ...	30′
Ore, ...	1′
Ferriferous limestone, ...	7′
Shale, ...	40′
Clarion [lower] coal, ...	1′
Shale, ...	50′
Homewood sandstone, massive, ...	40′
Soft shales, ...	10′ to 15′
Cannel slate, ...	1′
Fireclay, ...	3′
Concealed to level of run, ...	20′

20.



The base of this section is nearly forty feet above railroad level.

§ 174. *The Ferriferous limestone* lies two hundred and twenty above railroad level, at Lawsonham. A section of two hundred and twenty-one feet of measures, compiled from exposures near Pike Furnace, is shown by Fig. 20.

The Ore has been mined from numerous drifts driven into the hillsides for long distances, in some instances running completely through from side to side,—and an immense quantity of ore extracted, most of which was used by Pike furnace. About thirty thousand tons of the ore (as I am informed by Mr. McCoy) were shipped to Red Bank and smelted in that furnace after Pike furnace had been out of blast for some time.

§ 175. The old workings are now all fallen shut and cannot be entered, but the immense dump-heaps forming a broad terrace surrounding the hill bear record to the extent of the diggings. The ore was usually estimated at ten inches, though its thickness was not at all constant, sometimes running down to a few inches, and again measuring as much as two feet; it probably averaged the former figure. Very little ore remains in the round-top near Lawsonham station, but the hill next north of it evidently still contains a large and comparatively untouched area.

In mining the ore a sufficient quantity of the Ferriferous limestone was taken out with it to form a flux. It is still quarried to some extent for agricultural purposes by the farmers living near the workings.

§ 176. *The Kittanning Lower coal* has been opened and mined at two or three places near the ore diggings, but the entries have all long since fallen shut. The coal here lies thirty feet above the Ferriferous limestone.

In the summit, one and a half miles north of Lawsonham, the *Freeport Upper coal* should be found, but it has not been opened for working. Its presence seems to be indicated near the highest part of the hill by a line of smut often noticed on newly ploughed ground by those residing in that vicinity.

§ 177. *The Homewood sandstone* juts out in sharp escarpments along Pike and Wildcat runs. It is thick, hard and massive, in one place measuring over forty feet, but rests upon a soft shaly floor, which at times swells upwards and cuts out more than half the rock. A thin vein of *cannel slate*, which may be a representative of one of the *Mercer coals* is found in these shales at from ten to fifteen feet beneath the base of the sandrock. It is underlain by a bed of fireclay three feet thick.

The Homewood sandstone keeps above water level on Wildcat run as far up as Wildcat furnace. It is laid bare at several points by cuttings on the Sligo branch railroad. In these cuts it is frequently much broken up by false bedding.

The Ferriferous limestone keeps above water level for some distance above the furnace, finally passing out of sight beneath the dividing ridge near Reimersburg. It is quarried at a few places along this run, but comparatively little stone is taken out, excepting at the already mentioned quarry near Lawsonham.

§ 178. Broad terraces made by the rejected shale of the ore workings now mark the hills on both sides of the valley. These have been made by the workings of both Pike and Wildcat furnace. The latter was built of stone taken from the Homewood sandstone. It was one of the most successful of all the Clarion county charcoal furnaces.

On Wildcat run and its branches the "Ferriferous" ore-bed ranges from nine to twelve inches, with an occasional thickening to eighteen inches.

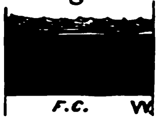
§ 179. *The Freeport Upper coal* exists in three or four isolated knobs northeast of Lawsonham. It has been drifted upon and small quantities taken out for local use, but the bed lies near the hill-top and has so little cover that it is nearly valueless.

The Homewood sandstone and *Ferriferous limestone* are kept above water level for a long distance up Turkey run by the noticeably rapid northwestwardly rise from the Lawsonham synclinal to the crest of the Brady's Bend anticlinal.

§ 180. *The Kittanning Lower coal* has been opened near Mr. T. Ramsey's house in the northwestern part of the township. It shows three feet of workable coal with one two very thin slaty laminæ but its value is greatly lessened by the irregular masses of pyrites which occur in many parts of the bank. The bed measures: Fig. 21.

§ *181. T. Ramsey coal bank.*

Fig. 21.



Dark shale roof.	
Bony coal,	4″
Coal,	3′ 0″
Fireclay floor.	

The Kittanning Middle and *Upper* coals have both been prospected upon near New Athens, but being quite thin have not been opened for mining. At two or three openings on the *Kittanning Middle coal* the bed presented only eighteen inches of workable coal.

§ 182. *The Freeport Upper limestone* is exposed on the Brady's Bend road near New Athens. An average sample yielded by analysis (McCreath):

	No. 27.
Carbonate of lime,	93.803
Carbonate of magnesia,	2.270
Oxide of iron and alumina,	.765
Phosphorus,	.008
Insoluble residue,	1.800

"Rather fine grained; mottled and seamed with calcite. Dark grey."

This analysis shows that at this locality the bed is a much purer limestone than at other places in Clarion county.

§ 183. West of New Athens the *Freeport Lower sandstone* is an extremely hard and massive conglomerate rock. It covers the hill slopes with large scattered blocks which at first sight seem to come from a horizon in the Kittanning group.

§ 184. *Natural Gas-springs* have been known for a long time on Catfish run and from time have been fired and allowed to burn. The one now burning was fired about two years ago and has been burning continuously ever since. The gas burns with a steady flame about two feet high and covers an area three or four feet in diameter. It issues from fissures in a rock lying just below water level in the stream, but its source is undoubtedly in some much deeper stratum; probably the Oil Sand group.

§ 185. *The Mercer Upper coal*, or a bed lying at its horizon, is opened on Catfish run near Rankin's grist mill. It measures two feet of workable coal, with a thin slate parting near the middle. The Homewood sandstone forms its roof. This coal is said to burn freely, and is much better liked by those who use it than coal from the Kittanning Lower bed.

§ 186. *The Freeport Upper coal* is opened and mined by Mr. A. W. Rush and Mr. C. D. Hutchinson. It averages about three and a half feet of workable coal, but the bed is subject to frequent and sudden local variations. It is used only to supply the local demand.

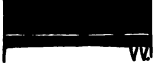
At Reimersburg the same coal is opened and mined quite largely from the round-top just south of town. It is here about four feet thick and furnishes a much esteemed coal, but unfortunately from lack of cover it is too soft to bear much handling.

§ 187. At Catfish the river hills are very steep, in some places measuring an average slope of nearly forty degrees, thus affording excellent facilities for the erection of inclined planes. Several of these now exist, besides many abandoned inclines of which nothing remains but the old dumps and road-beds. The seam worked at these planes is the *Kittanning Lower coal.* At the bank south of Catfish station, owned and worked by the Pittsburgh Coal and Mining Company, the bed measures about three feet and eight inches of workable coal as shown by Fig. 22, thus:

§ *188. Catfish coal bank.*

Shale roof, seen,	25′	
Slate and coal,	10 ″	4′ 6″
Coal,	10 ″	
Pyrite,	½″	
Coal,	4 ″	
Soft, bony parting,	1 ″	
Coal,	1′ 10 ″	
Soft parting,	½″	
Coal,	6 ″	
Fireclay floor.		

22.



This coal having a large percentage of volatile matter is a strong steam coal, but as it contains much sulphur is not desirable for other purposes; otherwise it would make a most excellent gas coal. It is largely used under the locomotive boilers of the Allegheny Valley railroad, and is supplied to many oil refineries along the Allegheny and Oil Creek valleys.

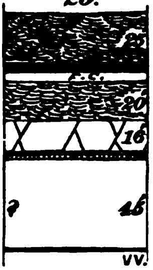
§ 189. *The Brady's Bend synclinal* trough just touches the river at Catfish, near the above described coal bank. Going northwardly from Catfish to Hillville there is a very perceptible rise in the coal rocks, and in the opposite direction also towards Red Bank, a rise of thirty-five feet per mile obtains for a distance of two miles, which carries the coals up across the bend to the crest of the Brady's Bend anticlinal.

A fragmentary section of one hundred and twenty feet was obtained in the ravine south of Catfish, near the path that leads over the neck of the bend. It reads as follows (Fig. 23):

§ 190. *Catfish Section.*

Shale,	25′
Kittanning Lower coal,	5′
Fireclay,	5′
Sandy shale,	20′
Massive sandstone,	16′
Ore,	1′
Ferriferous limestone,	3′
Concealed,	45′
Clarion [lower] coal (thin),	1

23.

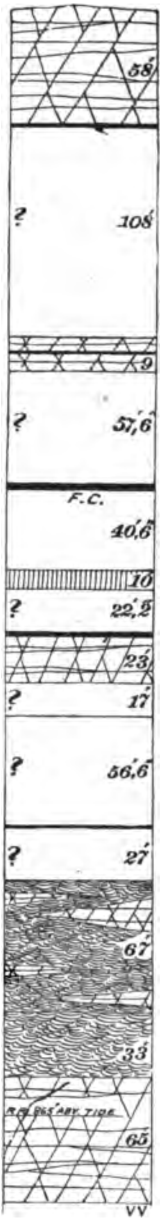


The Ferriferous limestone is exposed in the bed of the run which lies between the two inclined planes. Only three feet of the rock was seen. It is overlaid by six inches to one foot of ore, on which rests a remarkably hard and massive, cataract forming yellowish sandstone sixteen feet thick. The Kittanning Lower coal lies forty feet, more or less, above the limestone at this exposure.

§ 191. The coal mined by the Pittsburgh Coal and Mining Company, at Hillville, is the *Kittanning Lower bed.* It averages about three feet six inches of workable coal.

The accompanying section, Fig. 24, was made and kindly given to the survey by Mr. John Haggerty, M. E. of East Brady. It shows the relative positions of the Brookville coal, the Clarion [Lower] coal, the Kittanning Lower and Upper, and the Freeport Upper coal and the place of the Ferriferous limestone at Lower Hillville. The Kittanning Middle and the Freeport Lower coals being either very thin or altogether absent, are not shown in the section. The lowest coal shown in the cut lies in the Conglomerate measures, and may be the same with the coal already described at Rankin's grist-mill.

24.



A description of this section made from the drawing reads thus, (fig. 24):

Hillville section.

Interval with Mahoning sandstone,	28′
Freeport Upper coal,	2′
Concealed, sand at bottom,	108′
Kittanning Upper coal,	1′ 5″
Sandstone,	9′
Unnamed,	(?) 57′ 6″
Kittanning Lower coal,	3′ 6″
Shale with sandstone,	40′ 6″
Ferriferous Limestone,	10′
Unnamed,	22′ 2″
Clarion coal,	2′ 2″
Clarion sandstone,	23′
Brookville coal,	thin.
Unnamed,	17′
Unnamed,	56′ 6″
Coal, (Mercer ?),	1′
Unnamed,	27′
Sandstone and shale,	67′
Olive shale,	33′
Sandstone to river bed,	65′

The uppermost sandstone shown near the summit is the Mahoning sandrock. It is only found in one or two small roundtops back of Hillville.

§ 192. *The Sarah Furnace coke yards* and coal banks are situated west of the Red Bank Furnace mines. They are also on the *Freeport Upper coal* and present features similar to those already described.

Toby Township.

§ 193. This lies east of Perry and north of Madison township. It is principally occupied by the outcrops of the Kittanning and Freeport coal groups, but on Cherry run the Homewood sandstone occupies a small area. The Ferriferous limestone is above water level along Wildcat run and on the branches of Licking creek in the northern part of the township.

§ 194. The coal supply is amply sufficient to meet the local demand for centuries to come, but there are only a few localities at which it can be profitably mined for shipment. There is an abundant supply of limestone and an immense body of comparatively undisturbed and accessible ore in this township.

§ 195. *The Freeport Upper coal* is caught in several of the higher summits in the southwestern part of the township with a maximum covering of about thirty feet of shale in which there is at times a trace of the *Mahoning sandstone* sometimes forming the roof of the coal. The bed usually averages about four feet of workable coal resting on fireclay bottom, but is as variable here as at Red Bank so that no given thickness can safely be pre-supposed to exist. It apparently lies in "pots" separated by areas in which it is subject to sudden and radical changes.

At the opening owned by Mr. Robert Murphy the bed consists of the alternation shown by Fig. 25, thus:

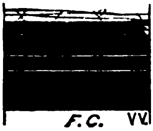
§ *196. Robt. Murphy Coal Bank.*

Sandstone roof.

Slaty coal,	8 "	4' 6½"
Coal,	1' 0 "	
Pyrite band,	½"	
Coal,	9 "	
Bone,	1 "	
Coal,	2' 0 "	

Fireclay floor.

25.



In this bank the bed shows sudden changes referable to variations in the sandstone roof which sometimes pinches it down to a two foot seam.

§ 197. *The Freeport Upper limestone*, four feet thick underlies this coal about six feet, but it is not always readily found, indeed it is often apparently absent. It seems to be a local "pot deposit," but this condition may be due as much to the accidents of erosion as to original irregularities of deposition.

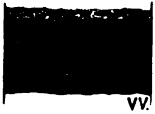
The Freeport Lower coal has been opened by Mr. T. Murphy at a bank where the bed shows the structure illustrated by Fig. 26.

§ *198. T. Murphy Coal Bank.*

Sandy shale roof,

Draw slate,			2' 0 "
Coal,		1' 1 "	3' 9¼"
Parting,	1 " to	2 "	
Coal,		1' 0 "	
Parting,	½" to	1 "	
Coal,		5 "	
Parting,		¼"	
Coal, (seen,)		1' 0 "	

26.



§ 199. This is an excellent coal, yields little ash and is tolerably free from sulphur. The following analysis was made by Mr. McCreath from an average sample taken from a heap that had lain exposed to the weather for several months, which fact probably accounts,—partially at least,—for the large percentage of water shown by the analysis.

	25.
Water,	4.775
Volatile matter,	35.118
Fixed carbon,	53.632
Sulphur,	1.095
Ash, (cream)	5.380
	100.000
Coke per cent.,	60.107
Fuel ratio,	1:1.52

"Lustre, dull black; bands of greyish-black coal throughout specimens. Compact and brittle with somewhat cubical fracture. Coke, inferior. Dry coal re-absorbs water rapidly."

This coal lies from one hundred and eighty to two hundred feet above the Ferriferous limestone.

§ 200. One mile northwest from Mr. Riegle's and about two and a half miles northeast from Reimersburg both the *Freeport Lower coal* and *limestone* are seen in outcrop at the roadside. The coal lies in several round-tops with barely sufficient cover to insure hardness. It is apparently about four feet thick. The limestone lies two or three feet beneath it and is probably two or three though possibly four or five feet thick.

§ 201. A sample of this limestone obtained at an exposure on the roadside gave by analysis (McCreath):

	24.
Carbonate of lime,	82.000
Carbonate of magnesia,	6.311
Oxide of iron and alumina,	2.736
Phosphorus,	.015
Insoluble residue,	7.940

"Exceedingly hard and tough; mottled and stained with ferric oxide. Color generally bluish grey."

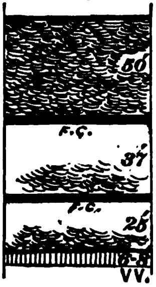
It lies about one hundred and ninety feet above the Ferriferous limestone. The hills in this vicinity are not high enough to catch the Freeport Upper coal.

§ 202. *The Kittanning Upper coal* forms a prominent bench on the hillsides along Wildcat run at an elevation of about one hundred and twenty-five feet above the Ferriferous limestone. It has been opened at one or two places and was found to measure eighteen inches. It is not worked. A section compiled in this neighborhood is shown by Fig. 27, reading thus:

§ *203. Section on Wildcat run.*

Kittanning Upper coal,	1′ 6″
Shales,	50′
Kittanning Middle coal,	3′ 8″
Fireclay,	37′
Shale, sandy,	
Kittanning Lower coal,	3′ 0″
Fireclay,	25′
Shale,	
Ore,	0′ 6″ to 0′ 8″
Ferriferous limestone,	6′ 0″ to 8′ 0″
Total,	129′

27.

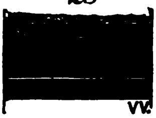


Fifty feet below the Kittanning Upper coal, Mr. Summerville has opened a bank on the *Kittanning Middle* bed. This coal here exhibits an unusual thickness, measuring nearly four feet in some parts of the bank. One measurement of it gave the succession illustrated by Fig. 28, reading as follows:

§ *204. Sommerville coal bank.*

Shale roof.		
Slaty coal,	7″	3′ 8″
Coal,	2′ 0″	
Slate,	1″	
Coal (about)	1′ 0″	
Fireclay floor.		

28



§ 205. The bed is rather slaty and does not furnish what would be denominated a first-class coal, but is tolerably free from sulphur and is a very free-burning coal. The following analysis was made by Mr. McCreath from an average sample of this coal.

		23.
Water,		1.410
Volatile matter,		36.900
Fixed carbon,		46.917
Sulphur,		1.583
Ash,	(grey-red tinge),	13.190
		100.000
Coke, per cent.,		61.690
Fuel ratio,		1:1.27

"T. O. Sommersville's bank. Lustre deep black; numerous bands of greyish black ashy coal throughout specimens. Rather compact and brittle."

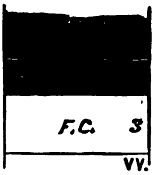
The Kittanning Lower coal has been opened by Mr. Reigle at a bank lying from thirty-five to thirty-seven feet below the Sommerville bank. The coal variably measures three feet to three feet and six inches. In some places three or four inches of slaty coal is superimposed upon the good coal. This bed lies fully twenty-five feet above the Ferriferous limestone as proven by a well dug by Mr. Reigle in which he went over twenty feet below the coal without reaching the limestone.

§ 206. Mr. John Hoover and Wm. Reigel, Esq., have both opened quarries on the *Ferriferous limestone*, which here lies at road level and only a few feet above the bed of Wildcat run. It measures about six feet with six or eight inches of suprajacent plate-ore. The stone burns readily, yielding an excellent, quickly-slacked white lime. Its outcrop keeps above water-level along the eastern branches of Wildcat run, passing out northeastwardly into Porter township.

§ 207. *The Sligo Branch Coal Company* are working the *Kittanning Lower coal* by two drifts, from which seventy-five to one hundred tons are daily mined. These banks have been in operation for several years, and a large amount of coal has been taken out. A normal average measurement of the bed shows, (Fig. 29):

§ *208. Sligo Branch coal bank.*

29.



Black slate roof.		
Coal,	1′ 8″	3′ 6″
Parting,	1″	
Coal,	1′ 9″	
Fireclay floor,		3′

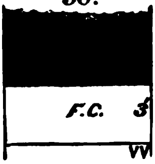
The slate parting is persistent, but the bed constantly varies, running from three feet up to four feet and six inches, being thickest in the swamps, and thinning away on the hills. It is a fair steam coal, but rather too pyritous for other purposes. An average sample yielded by analysis, (McCreath):

	No. 22.
Water,	1.370
Volatile matter,	41.575
Fixed carbon,	49.816
Sulphur,	2.824
Ash, . . . (cream)	4.415
	100.000
Coke, per cent.,	57.055
Fuel ratio,	1:1.19

"Average sample. Deep black, shining; shows a good deal of pyrites in masses throughout specimens." It is almost needless to say that this coal is unfit for iron making. It doubtless owes its popularity to its free burning character.

§ 209. Besides the banks owned by the Sligo Branch Company, there are a large number of old country banks upon this bed, most of which are in disuse or are only worked during the winter months to supply the local demand, or merely to meet the owners' wants. At Mr. Stevens' opening the coal measures somewhat over three feet of good coal, the slate parting being very thin, thus: (Fig. 30):

30.



Stevens' coal bank.

Shale roof.	
Coal,	3′ 2″
Fireclay floor, (seen)	3′ 0″

The bed shows many large masses of pyrites distributed irregularly through the coal.

§ 210. *The Kittanning Middle coal* forms a prominent bench running around the hillsides at a height of about fifty feet above the company's banks. It is eighteen or twenty inches thick but is not mined. The hills are not high enough to catch the Freeport group of coals.

The Ferriferous limestone has been found and opened at several places in the hollow below the Sligo Branch coal banks, which it underlies by about twenty-five or thirty feet. It is from six to eight feet thick. The ore band has been mined to some extent but it is not persistent; the operations upon it have therefore been circumscribed.

§ 211. *The Brady's Bend anticlinal* keeps the *Kittanning group* above water level far beyond the place at which it would otherwise disappear beneath the Reimersburg dividing ridge. Going northwardly and northwestwardly from town the *north dip* into the Brady's Bend synclinal is quite strongly marked. This keeps the Ferriferous limestone below water level along the railroad alignment,' so that it is not again seen until the road begins to descend into the valley of Licking creek near Sligo.

On the south side of this valley the Kittanning Lower coal, the ore, and the Ferriferous limestone have all been worked on a tract adjoining the railroad. They present about the same features as at Sligo in Piney township.

§ 212. On Cherry run in the northwestern part of the township the *Homewood sandstone* and a few feet of underlying measures are brought above water level. It is a hard, massive rock varying from thirty-five to fifty feet in thickness, outcropping in steep,—often abrupt,—escarpments, and strewing the slopes beneath with huge blocks of irregular shape. A thin bed of coal, possibly a representative of the Mercer group has been found in the subjacent shales. It is quite free from sulphur and has been dug to some extent for smithing to which use it seems admirably adapted. It is not mined at present.

The Ferriferous limestone here lies sixty-five feet above the Homewood sandstone and double that height above water level.

The Clarion coal probably two or two and a half feet thick is seen in blossom on the road in its normal position. It is not mined.

§ 213. Going up Cherry run the strong *southeast* dip into the *Brady's Bend synclinal* axis is easily detected without the aid of instruments.

It carries the Ferriferous limestone, in a distance of two miles, from one hundred and twenty feet above water level down to the stream bed near the Methodist camping grounds.

The Kittanning Lower coal is mined by Mr. G. W. Courson at a bank near the Brundred and Marston oil well. A measurement of the bed gave the structure illustrated by Fig. 31.

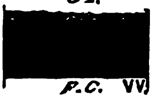
§ *214. Courson coal bank.*

Shale roof.

Coal,	1′ 1″	2′ 11″
Slate,	½″ to 1″	
Coal,	1′ 9″	

Fireclay floor.

31.



This bank is opened *with the dip*; the drainage is consequently very bad. It lies thirty feet above the Ferriferous limestone which has been quarried from the bed of the run only a few rods from the bank.

The Kittanning Middle coal is opened at Mr. Henry Courson's on the railroad one mile and a half east from Mr. G. W. Courson's bank. It is only eighteen inches thick.

Oil Wells.

§ 215. In 1877 Messrs. Watson and Prosius started and drilled a test well near Reimersburg. The well mouth is situated a few feet above the Kittanning Lower coal or about fifty feet above the Ferriferous limestone. Salt water was struck at 500 feet and the well cased at 540 feet. Gas was struck in what was called the "First sand" (probably the "Third mountain sand" or "Berea grit") at about 800 feet. The flow of gas was very small; not nearly enough to fire the boiler. A depth of 1350 feet was reached without finding oil in paying quantities. This depth referred to the Ferriferous limestone as a plane for comparison, places the bottom of the well below the horizon of the Armstrong and Butler county "Fourth sand."

The Cherry Run oil well drilled by Brundred and Marston starts at the horizon of the Ferriferous limestone. The conductor stands on the sandrock which in this vicinity immediately underlies the limestone. This well struck a large flow of gas and some little oil was also obtained, but not enough to pay for pumping. The record reads as follows :

§ 216. *Cherry Run Oil Well.*

On Plyer farm, Toby township—drilled in May, 1878. Duplicate of copy taken by Mr. A. B. Howland from a record in possession of Jos. D. Potts, Esq.

Well mouth above ocean,	—		—
Conductor,	5'	to	5'
Limestone missing,	—		—
Sand and shells,	56'	to	61'
Sandstone,	15'	to	76'
Slate, &c.,	35'	to	111'
Sandstone,	150'	to	261'
Slate,	5'	to	266'
Sandstone,	185'	to	451'
Slate and shales,	130'	to	581'
Sandstone,	44'	to	625'
Slate and shale,—oil,	283'	to	908'
Sandstone,—gas,	105'	to	1013'
Slate, 5'			
Sandstone, pebbles,—gas,			
Slate (5' red) shells and slate,	35'	to	1048'
Sandstone; blue,	12'	to	1060'
Slate; red,—sand shells,	30'	to	1090'
Slate,	5'	to	1095'
Sandstone,—"bowlder,"—solid,	23'	to	1118'
Slate,—3' red,	15'	to	1133'
Sand,—red, brown, and yellow,	15'	to	1148'
Slate, blue; hard shells, slate and shells,	28'	to	1176'
Sand; black and yellow pebbles,	3'	to	1179'
Red Rock, sandy slate, brown olive gritty shales, soft rock, white shell,	9'	to	1188'
Sandstone,—pebbles 1193' oil,	15'	to	1203'
Shale; red, olive, hard gritty shale more sandy, white sand. Red gritty shales, sandy flags, white shell, grey sand, blue sand, white shell, sand slate,	32'	to	1235'

Shells; red, olive and white sands. Red rock, olive shales, blue slate. Hard yellow and white pebbles,	26' to 1261'
Sandstone; close, white, hard,	9' to 1270'
Slate,	13' to 1283'
Sandstone; oil at 1287',	9' to 1292'
Slate,	10' to 1302'
Sandstone; loose, oily,	5' to 1307'
Shells, &c.,	11' to 1318'
Sandstone; oily all through,	19' to 1337'
Slate; blue,	63' to 1400'

Oil shows at 1143', 1193', 1287' and in the 5' and 19' sand-rocks.

As this well starts on a level with the Ferriferous limestone, and was drilled to a depth of 1400′ it is about one hundred feet deeper (geologically) than the Reimersburg well. It is undoubtedly through the horizon at which we should expect to find the oil rock representatives.

Porter Township.

§ 217. This township lies east of Toby and Madison townships and south of Monroe and Limestone; its southern edge borders on Red Bank creek which separates it from Armstrong county. It is approximately square, measuring about six and a half miles in either a north and south or east and west direction, its area being about forty-two square miles.

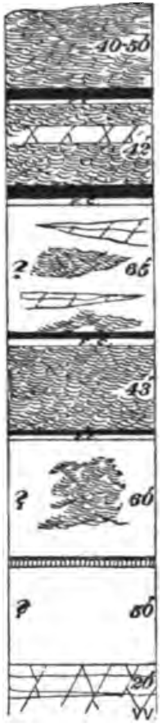
It is crossed by the following flexures: Lawsonham synclinal, Kellersburg anticlinal, Centreville synclinal and Anthony's Bend anticlinal. The north dips of all these axes are very slight and do not make any noticeable topographical features; the south dips are steeper, this is especially true of the descent along the north side of the Anthony's Bend anticlinal towards the synclinal basin at Fairmount in Red Bank township.

§ 218. The township is bountifully supplied with coal of excellent quality; the *Ferriferous limestone* is accessible along all the larger streams and a large body of untouched ore yet remains. *The Freeport Upper* and *Lower coal beds* are seams of unusual purity and thickness, but their workable area is confined to a few isolated hilltops.

The Kittanning Lower coal is not so valuable as in the country either west or east of this township but the *Kittanning Middle coal* though thin is an excellent bed and will eventually be of considerable importance. At present a bed of its size cannot be profitably worked. It is completely overshadowed by the thicker and purer Freeport beds.

The following section, shown by Fig. 32, was compiled from exposures near New Bethlehem. It fairly represents the sequence seen in any part of the township.

32.



§ *219. New Bethlehem section.*

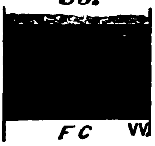
Shaly measures in summit, . . .	40′-50′
Freeport Upper coal, ...	5′
Fireclay, ...	3′
Sandy shale with 10′ hard massive SS.,	42′
Freeport Lower coal, ...	7′
Fireclay, ...	3′
Concealed sandstone and shale, .	65′
Kittanning Upper coal,—in gutter, .	2′- 3′
Fireclay, ...	4′
Shale, ...	43′
Kittanning Middle coal, ...	2′
Fireclay, ...	3′
Concealed, ...	60′
Ore, ...	1′
Ferriferous limestone, ...	4′
Concealed, ...	50′
Homewood sandstone (seen)	20′
Total, ...	365′

The base of this section is about twenty-five feet above railroad level at New Bethlehem.

The Freeport Upper coal has been opened and worked on Mr. Goheen's farm east of the Oak Vale school-house. The coal dips gently westward towards the Centreville synclinal and as the bank is opened in opposite direction the bed drains itself. The coal measures four feet and nine inches with no persistent or even perceptible slate partings, but the uppermost eight or ten inches contain some very thin slaty laminæ. One measurement of this bed gave:

§ *220. Goheen's* (*upper*) *coal bank.*

33.



Slate roof.
Coal, somewhat slaty, ... 9″ } 4′ 9″
Coal, ... 4′ 0″ }
Fireclay floor.

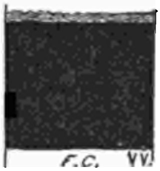
§ 221. Some layers of the coal contain much mineral charcoal; it is due to this peculiarity that the St. Charles furnace men were enabled to use it in a raw state for smelting iron. The following analysis was made by Mr. McCreath from an average sample of this coal. The specimens were evidently from soft outcrop coal and had been lying exposed to the weather for a long time.

	13.
Water, ...	1.520
Volatile matter, ...	35.320
Fixed carbon, ...	54.448
Sulphur, ...	.672
Ash, ...	8.040
	100.000
Coke, per cent., ...	63.16
Color of ash, ...	cream.
Fuel ratio, ...	1:1.54

§ 222. The hill in which this bank is opened is a roundtop, capped by the Mahoning sandstone and overlooking the valley of Red Bank creek. It probably does not hold more than twenty-five acres of hard coal. Forty-five feet beneath this coal Mr. Goheen has a bank opened on the Freeport Lower coal. The Freeport Upper sandstone, hard and massive, occurs between these two coals. It strews the ground with fragments, and its escarpment makes the profile of the hilltop very sharp and bold.

The Freeport Lower coal is said to be very thick in some parts of this bank. Where measured it presented six and a half feet of good coal, with no slate partings, thus: (Fig. 34.)

34.



§ 223. *Goheen's (lower) coal bank.*

Slaty shale roof, hard.
Coal, ... 6′ 6″
Fireclay floor.

§ 224. This fine development is but a duplicate of its form at Fairmount, and the following analysis, made by Mr. McCreath from an average sample, shows that its quality is nearly as good.

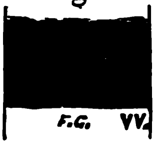
	No. 12.
Water, ...	1.170
Volatile matter, ...	39.155
Fixed carbon, ...	51.388
Sulphur, ...	2.067
Ash, ...	6.220
	100.000
Coke, per cent., ...	59.675
Color of ash, ...	gray.
Fuel ratio, ...	1:1.31

"Lustre deep black; generally very firm and compact. Partings of pyrites somewhat numerous. Shows numerous fossil impressions filled in with pyrites."

As this bed lies forty-five feet lower than the Freeport Upper coal, its workable area in this hilltop is considerably greater than that of the former. Its floor and roof seem to be quite low, and present a dip west by north towards the Centreville synclinal. It here lies about four hundred and twenty feet above railroad level.

This Freeport Lower coal has been opened by Mr. Lowrie, at a bank situated about one mile north from New Bethlehem. The bed shows, (Fig. 35):

Fig. 35.



§ 325. *Lowrie's coal bank.*

Black slate roof.
Coal, ... 4′
Fireclay floor.

The coal is hard and apparently of good quality, with very little sulphur. It has a maximum cover of about one hundred feet of measures.

§ 226. On the adjoining farm and forty feet below this coal, Mr. Bowersox has drifted upon the *Kittanning Upper coal*, which is from two to three feet thick in this vicinity. The entry is now closed. The interval between these two beds is much less than the normal space, showing a noteworthy decrease from Fairmount, where it measures ninety-five feet. But this does not seem very extraordinary when we remember that one mile and a half south of New Bethlehem, in Armstrong county, the same interval is reduced to twenty-five feet. (See § 249.)

On the opposite side of the hill from the Lowrie opening, Capt. Brinker has drifted upon this bed and found seven feet of coal, and has also sunk several trial pits from the summit to what he at first thought the *Freeport Lower coal*, but which he probably never reached. The coal struck in the shafts was evidently the *Freeport Upper coal.* It is from two to three feet thick. If this bed be the *Freeport Lower coal*, there must be a steep dip from the shafts *down* to Lowrie's, but nothing of the kind can be detected, and the normal rate of dip into the Fairmount synclinal, when carried across the hill from the one opening to the others, shows that the shaft coal is higher than the Lowrie opening.

§ 227. Three and a half miles north from New Bethlehem the *Freeport Lower coal* is opened at a bank formerly owned by Mrs. McNutt, but which is now in the possession of Mr. Smullen. The opening is situated high up on the west side of the hill facing Leasure run. It is very nearly on the crest of the *Anthony's Bend anticlinal*, being five hundred and fifty feet, more or less, above New Bethlehem. One measurement made at this opening gave the structure shown by Fig. 36. The bed yields an excellent hard bright coal, quite free from sulphur. There is at least five feet of good workable coal in sight.

§ 228. *Smullen Coal Bank.*

Thin-bedded, slaty roof, (seen,)		4′ 0″
Bony coal and slate,	2′ 6″	9′ 0½″
Coal,	4′ 0″	
Slate parting,	½″	
Coal,	2′ 6″	
Fireclay floor.		

Fig. 36.

The following analysis was made from an average sample of this coal: (McCreath.)

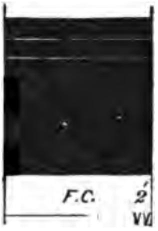
	17.
Water,	1.850
Volatile matter,	38.510
Fixed carbon,	54.669
Sulphur,	1.046
Ash,	3.925
	100.000
Coke, per cent.,	59.640
Color of ash,	reddish gray.
Fuel ratio,	1:1.42

"Lustre dull; somewhat coated with iron oxide; brittle; shows but little pyrites."

Both the *Freeport Upper* and *Lower* coal beds are opened on Mr. J. McKinley's land, just beyond the farm owned by Mr. Thomas. The Upper bed covers only a very small area as it lies quite close to the summit. *The Freeport Lower coal* is opened forty feet beneath the former, at an elevation of about four hundred feet above the railroad.

§ 229. At Mr. Jas. Wilkins' (McClure's mine), three miles north-northwest from New Bethlehem, and one mile and a half southeast from the Smullen bank, the *Freeport Lower coal* shows the following succession: (See Fig. 37.)

37.



§ *230. Wilkin's or McClure's coal bank.*

Coal, in roof,	1' 0"	8' 0"
Coal, rather poor,	1' 0"	
Coal, good,	6' 0"	
Fireclay floor (seen),		2' 0"

The magnificent development illustrated by the above cut is remarkable in that notwithstanding the immense thickness of the bed there are no regular slate partings visible. The following analysis, made by Mr. McCreath from an average sample of the lowermost six feet of this coal, shows a very low percentage of sulphur and ash.

	18.
Water,	1.640
Volatile matter,	37.115
Fixed carbon,	56.357
Sulphur,	1.163
Ash,	3.725
	100.000
Coke, per cent.,	61.245
Color of ash,	cream.
Fuel ratio,	1:1.51

"Lustre rather dull; somewhat coated with iron oxide; slightly iridescent."

§ 231. Though only seven feet of the coal was actually seen in the opening, there is an additional foot or more of coal which being of inferior quality is left as a roof to the bank. The uppermost two feet of the bed is rather slaty, but after throwing this aside there still remains six feet of workable coal of excellent quality, and this, too, extends over no mean area and has sufficient cover to insure hardness. The adjoining land which were a part of the Sligo furnace property, contain two hundred and sixty-four acres of this coal.*

---

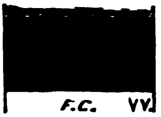
* According to Mr. John Haggerty, M. E., of East Brady.

§ 232. *The St. Charles furnace* coal lands lie between the Wilkin's bank and the openings on Mr. Goheen's and Mr. McKinley's farms. They contain a large area of the *Freeport Lower coal*, which was coked by the furnace men for use with *raw coal* from the Freeport Upper bed. The latter was used for several months as the sole fuel and made an excellent soft iron. It is filled with thin laminæ of mineral charcoal, which by preventing the coal from swelling and coking enabled it to bear the burden of the charge. This Freeport Upper coal bed shows an average of (Fig. 38):

§ 233. *St. Charles Furnace Coal Bank.*

Black slate roof.
Coal, ... 3′ 9″
Fireclay floor.

Fig. 38.



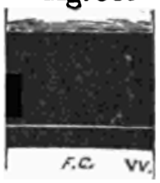
The Mahoning sandstone caps the summit, which rises to a height of about fifty feet above the coal.

The Freeport Lower coal where opened at Thos. Ditty's bank shows nearly six feet of good coal. The bank is only driven a very short distance into the hillside. It is located about one mile northeast from the Smullen opening. A measurement of the bed made by Mr. Platt (H, page 236) gave (Fig. 39):

§ 234. *Ditty's coal bank.*

Black slate roof.
Coal, ... 4′ 8 ″ }
Slate parting, ... ½″ } 5′ 8½″
Coal, ... 1′ 0 ″ }
Fireclay floor.

Fig. 39.



§ 235. Passing northwardly from New Bethlehem up Leasure run, the *Ferriferous limestone* and its associate measures are constantly in sight for a distance of nearly five miles. The limestone is always much higher on the west side of the run than on the east side. This is due to the strong southeast dip from the Anthony's Bend axis into the Fairmount synclinal. Two miles up the run on Mr. McNutt's farm, a bed of *cannel coal* has been opened up which is said to measure four feet. It lies about twenty-five feet below the Ferriferous limestone, and is therefore a representative of the *Clarion coal bed.* The occurrence of *cannel coal* at this horizon is a most unusual and noteworthy feature; the beds underlying the Ferriferous very rarely showing this character. The *Ferriferous limestone* is here (at Mr. McNutt's) about six feet thick and carries some kidney ore distributed through the suprajacent shales, but no plate-ore has been found on this farm.

§ 236. *The Kittanning Upper* and *Middle* coals are both exposed at several places in the road gutters east and west of Mr. Goheen's house three miles northwest from New Bethlehem. The thicknesses assigned them in the New Bethlehem section are mere estimates made from the character of the blossoms and the reports of persons who had prospected upon them.

§ 237. *The Ferriferous limestone* is quarried at an opening on Long run three quarters of a mile east of the cross roads at Mr. Goheen's. Four feet of the stone, overlaid by nine inches of plate-ore is laid bare by this working but its bottom is not exposed. An analysis of this stratum made by Mr. McCreath, shows:

	14.
Carbonate of lime, ...	95.232
Carbonate of magnesia, ...	.407
Oxide of iron and alumina, ...	1.310
Phosphorus, ...	.061
Insoluble residue, ...	2.190

"Brittle, more or less stained with ferric oxide; generally pearl-grey."

The Homewood sandstone underlies the limestone from fifty to sixty-five feet, and can be seen at several fragmentary outcroppings on Long run. Some of its layers are conglomeritic with pebbles as large as a pea, but the average size of its sand grains is much smaller. Where exposed near the limestone quarry it is over two hundred feet above railroad level, but the strong descent into the Fairmount synclinal brings it down to the railroad at the eastern edge of the township. The quarry on Long run is apparently on the crest of the Anthony's Bend anticlinal.

§ 238. West of the Wilkin's, Smullen and St. Charles coal banks the measures exhibit a gentle *west dip* and then a sharp *northwest rise* which keeps the Homewood sandstone above water level for a long distance up Leatherwood creek. This is the southeast dip of the *Kellersburg anticlinal.*

§ 239. At St. Charles furnace the Homewood sandstone lies from sixty to one hundred feet above stream level with the Ferriferous limestone and its ore bed from one hundred and twenty to one hundred and fifty feet above the creek. The southeast dip already mentioned throws the measures down much lower upon the east than on the west side of the creek. The place of the lime and ore are everywhere well marked by the broad terraces left by the mining operations.

§ 240. At Rockville one mile north of the furnace the *Homewood sandstone* is very massive, sometimes conglomeritic, outcropping in bluff escarpments on both sides of the valley. It varies from fifteen to thirty feet. The measures underlying it are not well exposed in this vicinity, but the existence of a small coal is reported and noted though the bed itself was not in sight. This rock passes beneath water level one mile above Rockville.

§ 241. *The Ferriferous limestone* keeps above water level for about five miles above the furnace. It has been dug at a few places but most of these openings are now fallen shut. At Mr. Hamm's near Brinkerton it is but three or four feet thick.

The Kittanning Middle and Lower coals lying respectively at seventy-five and twenty-five feet above the limestone have both been opened near Mr. Hamm's house. The former is not thick enough for profitable mining, but the *Kittanning Lower coal* shows from two feet and nine inches to three feet of good coal with no persistent partings of bone or slate.

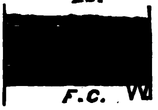
§ 242. *The Limestone ore* has been mined on Middle run in the southwestern part of the township for use in the St. Charles furnace. It varies from eight inches to two feet in thickness. *The Kittanning Lower coal* is about two feet thick and has been mined for local use. It lies thirty-five feet above the limestone which here is only forty feet above the Homewood sandstone.

In the northwestern corner of the township, Mr. Evan Will has just opened a bank on what is probably the *Kittanning Lower coal.* The coal looks bright and good, though the entry has as yet hardly passed through the outcrop coal. A measurement gave, (Fig. 40):

§ *243. Will's coal bank.*

Shale roof.		
Coal, ...	2′ 0″	3′ 0″
Soft bone, ...	1″	
Coal, ...	11″	
Fireclay floor.		

40.



The Freeport sandstone here caps most of the summits, but a few are high enough to catch the Freeport Lower coal, which is quite unlike its character near New Bethlehem and Fairmount, being thinner, of poorer quality, and often contains many slate bands.

In this part of the township the *Ferriferous limestone* occurs at from ten to sixty feet above water level in the larger streams. It is opened at very few places, but numerous diggings are still in sight where the farmers have from time to time mined the outcrop stone. The coals underlying the limestone are quite poor and thin, and are not opened, though nearly every farmer is aware of their existence.

§ 244. *The Freeport Lower limestone* has been dug by Mr. Brinker, in the northeastern corner of the township. It is called as the "flag-lime," in contradistinction to the Ferriferous, which is called the "rock-lime." As the name indicates, it is a flaggy stone, and not very highly esteemed as a fertilizer.

Red Bank Township.

§ 245. This township is situated in the southeastern corner of the county, next east of Porter and south of Limestone township with Jefferson county on its eastern line. It is separated on the south from Armstrong county by Red

Bank creek. Its average length, (east and west) is about six miles and its width five miles embracing therefore an area of about thirty square miles or more.

It is drained by Middle run, Town run and Pine run, the last two of which are streams of considerable size rising near the northern edge of the township on the Clarion-Red Bank divide.

The summits along the Brookville(?) and Anthony's Bend anticlinal axes are about five hundred and fifty feet above water level in Red Bank creek, but within the limits of the Fairmount basin they seldom exceed a height of four hundred feet.

§ 246. *The Fairmount synclinal* enters the township about half a mile east of Fairmount near the mouth of Town run where it brings the Ferriferous limestone down to low water level in the bed of Red Bank creek and passing northeast through the eastern part of the township passes out into Jefferson county near the junction line of Red Bank and Limestone townships. The south dip into this basin ranges from thirty to sixty feet per mile, but the northwest dip is much steeper, averaging at least seventy-five feet per mile.

The Brookville (?) axis just touches the southeastern corner of the township. It crosses Red Bank creek between Maysville and Patton's station, and passing northeast runs out towards Brookville in Jefferson county. It lifts the Ferriferous limestone from water level at Fairmount, to a height of about three hundred and fifty feet in the hill northwest of Patton's station.

The Anthony's Bend anticlinal crosses the north-western corner of the township. Its northwest dip is very gentle.

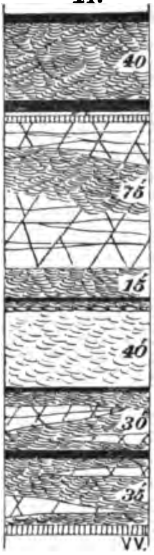
§ 247. *The coal supply* of this township is all that could be desired. The Freeport Upper and Lower coals are of superb quality and thickness, and cover an aggregate area of considerable size. The geological map shows very prettily how these coals brought low by the Fairmount synclinal axis are caught in the higher hills and roundtops along the centre of the trough, while the areas east and west occupied by anticlinal folds contain much higher summits but are nevertheless too low to catch these measures. The Kittanning coal group is well developed and will eventually become the source of a large output. This is especially true of the Kittanning Lower coal, which is accessible at almost any point and which usually furnishes an excellent coal.

A vertical section of two hundred and sixty-seven feet of measures, compiled from exposures at Fairmount, is shown by Fig. 41. It reads thus:

§ 248. *Fairmount Section.*

Freeport Upper coal (near summit),	4′
Shale [F. U. limestone not seen],	40′
Freeport Lower coal,	6′
Fireclay,	2′
Freeport Lower limestone (local),	3′
Sandstone and shale,	75′
Shale; soft,	15′
Kittanning Upper coal,	2′
Fireclay or shale,	3′
Johnstown cement bed (ore),	2′
Shaly measures,	40′
Kittanning Middle coal (1′ 6″),	2′
Shale, with some sandstone,	30′
Kittanning Lower coal,	4′
Sandstone and shale,	35′
Ferriferous limestone (at water level),	4′

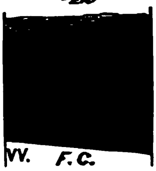
41.



The Freeport Upper coal just over-rides the hilltop at Fairmount, but has been found on the hill east of Middle run. It is said to be four feet thick, but has not been opened up for working.

The Freeport Lower coal is the bed worked by the Fairmount Coal Company. It lies about two hundred feet above the railroad track. A tramway laid with sixteen-pound rails runs from the pit mouth to the plane-head, a distance of half a mile, on which the mine cars are run by gravity to the plane, and thence directly lowered to the tipples. The bed measures, on an average, about six feet, as shown by Fig. 42, thus:

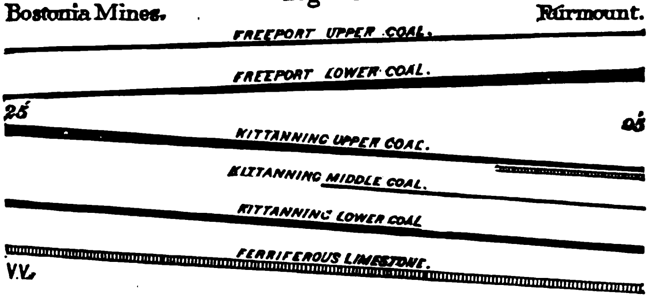
42



§ *249. Fairmount Coal Bank, No. 1.*
Black slate and cannel slate roof.
Coal, ... 5′ 6″ to 7′ 0″
Fireclay floor.

This coal contains no parting of slate or bone and not a single pyrite band of appreciable thickness. Its roof is rather variable, changing from slate to cannel slate, and from this to fire clay indistances of a few feet. The floor is generally a two-foot fireclay bed but sometimes changes to thin-bedded slate. It is quite even, *i. e.* its variations of level are not due to irregularities of deposition but are occasioned by local dips. The latter are of frequent occurrence, often throwing the coal five or ten feet above or below its normal position. The bed shows a gentle *average dip to the southwest*, but this is *not the dip of the coal measures* at this point, for the normal descent is *towards the southeast* into the Fairmount synclinal.

Fig. 43.



§ 250. Fig. 43 shows how this irregularity is due to a thinning away to the southeast of the interval between the Freeport Lower and Kittanning Upper coal beds, from ninety-five feet at Fairmount to about twenty-five feet at the Bostonia mines two miles from new Bethlehem. The coal is about fifteen or twenty feet lower at the plane-head than at the pit-mouth, and as the tram-road has just about twenty feet of grade, it runs around the hill on the outcrop of the bed.

§ 251. The following analyses, made by Mr. McCreath from average specimens, show the character of this Lower Freeport coal:

	No. 11.	*A.**	*B.**
Water, ...	1.320	1.700	1.320
Volatile matter, ...	40.565	38.930	40.800
Fixed carbon, ...	53.980	56.096	52.879
Sulphur, ...	1.490	.604	.881
Ash, ...	2.645	2.670	4.120
	100.000	100.000	100.000
Coke, per cent., ...	58.115	59.37	58.88
Color of ash, ...	reddish gray.	cream.	gray-red tinge.

No. 11. Deep black; brittle; laminæ rather indistinct; partings of mineral charcoal rather numerous.

"A." "Bright, resinous, hard, compact, with a small amount of pyrites."

"B." "Dull resinous lustre, containing veins of slate and considerable iron pyrites. Forms a coherent coke with metallic lustre."

§ 252. Capt. Brinker, the president and manager of the Fairmount Coal Company, has lately made a series of experiments with the *slack coal* from this bed, having in view the possibility of producing from it a marketable coke. For this purpose he had six coking ovens built at the coal tipple, and in them has coked not only the ordinary refuse slack coal, but "culled" slack and also washed slack. A *Stutz washer* has been erected at the tipple, through which all the slack now coked is first run. The washer is also used for washing coal sold for smithing purposes.

These experiments have been so satisfactory that the company have concluded to erect a large number of ovens, some of which are already building. [October, 1879.]

---

* Report H, page 230.

§ 253. The following analyses of washed and unwashed slack coal were made to ascertain exactly what benefit was derived by washing the coal. The large percentage of ash in the unwashed slack is due to the presence of a large amount of the *fireclay roof* which sometimes comes down with the coal.

	1.	*2.*
Water,	1.260	1.300
Volatile matter,	35.130	35.825
Fixed carbon,	51.397	54.223
Sulphur,	1.988	1.312
Ash,	10.225	7.340
	100.000	100.000
Coke, per cent.,	63.610	62.875
Fuel ratio,	1:1.43	1:1.51

No. 1 was made from average samples of unwashed slack.

No. 2 is an analysis of the washed slack.

§ 254. The washing is not as successful as might be expected, on account of the unequal size of the slack particles. If it were sifted and assorted into grades of different size, and washed separately with varying feed, much better results might be obtained. Mr. Brinker estimates the cost of washing at about twelve cents per ton, but on a large scale it would be much less. The resulting coke shows by analysis, (McCreath):

	3.	*40.*
Water,	.210	.030
Volatile matter,	.738	.623
Fixed carbon,	82.904	85.777
Sulphur,	1.360	2.107
Ash,	14.788	1.463
	100.000	100.000
Color of ash,	reddish-gray,	red.

No. 3. "Lustre silvery; structure rather dense; numer-

ous lenticular masses of slate,* especially in centre of specimen."

No. 40. "Structure open; lustre bright silvery; small masses of slate through specimens."

§ 255. The output from this colliery averages from two hundred and fifty to three hundred tons per day. It is nearly all sold for gas and steam use. As a gas coal it cannot be surpassed by any of the coals of the Lower Productive measures, and its exceptional thickness and freedom from bony or slaty partings combine to make it a most important and valuable bed. A contoured map of the Fairmount coal lands has already been printed in report H. It shows the available area of this bed upon the tracts controlled by this company.

The Freeport Lower limestone is not now exposed at Fairmount, but Mr. Brinker states that it has been found a short distance from the pit-mouth at an elevation a few feet lower than the coal.

§ 256. *The Kittanning Upper coal* is two feet thick, as determined by several prospecting drifts near Fairmount. At New Bethlehem this bed carries upon it a great deposit of cannel coal eight feet thick, which is probably the equivalent of the *Darlington cannel coal* of Beaver county, the *North Washington* and *Murrinsville cannel coals* of Butler county. It is underlain by fireclay or shale about three feet thick beneath which comes the *Johnstown cement bed* which is here a limestone ore of more ferruginous character than at the "Limestone narrows" in Armstrong county where Mr. W. G. Platt has found it nine feet thick. Its thickness is given as two feet in the section compiled at Fairmount (Fig. 41) but as its exposure was not clean enough to permit an accurate measurement, this must not be accepted for its exact size. The place referred to is ninety-five feet vertically below the pit-mouth of the Freeport Lower coal mine, and is situated about one fifth of a mile from the bank. The stone is a dark greyish-steel color, quite heavy and shows a few fossil markings. An analysis of this stratum made by Mr. McCreath, shows:

---

* This specimen is evidently not a fair average sample of the coke. Externally it seemed to be a true representative specimen, but its interior was found filled with an extraordinary number of small slate fragments.

	7.
Carbonate of lime,	25.089
Carbonate of magnesia,	6.008
Carbonate of iron,	37.596
Sesquioxide of iron,	1.571
Alumina,	4.851
Sulphur,	.083
Phosphorus,	.474
Insoluble residue,	20.100
Metallic iron,	19.250

This may be called either a calcareous ore or a ferruginous limestone. It would probably prove self-fluxing in a charcoal furnace.

§ 257. *The Kittanning Middle coal* has been dug into on the face of the hill overlooking Fairmount but is not opened up for working. It is reported as from eighteen inches to two feet thick.

An average sample of outcrop coal from one of these old prospecting holes on this Kittanning Middle coal yielded on analysis by Mr. McCreath:

	16.
Water,	4.765
Volatile matter,	35.675
Fixed carbon,	54.037
Sulphur,	.913
Ash,	4.610
	100.000
Coke per cent.,	59.560
Color of ash,	cream.
Fuel ratio,	1 : 1.51

"Lustre dull, dead; more or less coated with silt. Brittle; shows but little pyrites; yields an inferior coke. Dry coal re-absorbs water with great rapidity."

The above analysis shows a superior blacksmith coal, and were the bed somewhat thicker would be a very valuable seam. The time will yet come when this coal can be profitably mined.

§ 258. *The Kittanning Lower coal* is worked by the Fairmount Coal Company at their No. 4 drift. It lies on an extremely irregular fireclay or sandstone floor which pitches up or down eight, ten or even fifteen feet in distances of a few rods. The bed is rather sulphurous but yielding a strong steam coal finds ready sale for that purpose and is also sold to some amount for use under oil refinery retorts. One measurement of this bed gave the structure illustrated by Fig. 44.

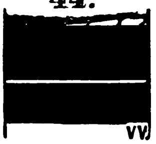
§ *259. Fairmount coal bank, No. 4.*

Hard shale and sandstone roof.

Slaty coal, ...	4″	4′ 11″
Coal, ...	2′ 4″	
Bone, ...	2″	
Coal, ...	1′ 0″	
Sulphur bands, ...	1″	
Coal, ...	1′ 0″	

Sandstone floor.

44.



The subjoined analyses Nos. 8, 9, and 10 were made by Mr. McCreath from specimens from each of the three benches and probably show a better analysis than would be obtained from the "run of the mine." They exclude the slate and pyrite partings. Analysis No. 4 shows the character of the slack coal from this bank.

§ *260. Analyses of Kittanning Lower coal.*

	No. 4.	*No. 8.*	*No. 9.*	*No. 10.*
Water, ...	.950	.850	.930	1.050
Volatile matter, .	39.695	39.655	41.000	38.955
Fixed carbon, . .	48.405	49.787	48.571	41.357
Sulphur, ...	3.440	1.548	1.534	5.773
Ash, ...	7.510	8,160	7.965	12.865
	100.000	100.000	100.000	100.000
Coke, per cent., .	59.355	59.495	58.07	59.995
Color of ash, . . .	lilac.	red-grey.	white.	pink.
Fuel ratio, ...	1:1.23	1:1.25	1:1.18	1:1.06

No. 4. Kittanning Lower coal,—slack.

No. 8. Kittanning Lower coal, upper bench. "Lustre deep black; bands of bright pitchy coal run throughout the mass, also bands of greyish black ashy coal."

No. 9. Kittanning Lower coal,—middle bench. "Same general appearance as No. 8."

No. 10. Kittanning Lower coal,—lower bench. "Lustre deep black, rather tender; carries an unusually large number of thin partings of iron pyrites more or less decomposed."

§ 261. Coke has been made from this slack coal but its quality is very poor. It is safe to say that much improvement may be expected by washing the slack preparatory to coking it. Two analyses made by Mr. McCreath show:

	No. 5.	*No. 41.*
Water,	.020	.020
Volatile matter,	.510	.603
Fixed carbon,	84.588	82.898
Sulphur,	2.672	2.936
Ash,	12.210	13.543
	100.000	100.000
Color of ash,	reddish brown,	red.
Phosphorus,	.012	

No. 5. "Bright silvery; rather coarse grained and dense; small lenticular masses of slate throughout specimens."

§ 262. The *Ferriferous limestone* is probably about eight feet below the railroad at Fairmount, but one quarter of a mile east of the station it is exposed in the Red Bank creek stream-bed. I do not think that it actually descends below low-water mark at this point. It has been quarried from the bed of Middle run a few rods above the railroad crossing, but this working is now abandoned, and the exposures being somewhat filled with earth do not show its whole thickness. After passing beneath water level on Middle run a short distance above its mouth, the limestone again appears one mile further up the stream and continues accessible for a distance of nearly a mile when it finally disappears beneath the high lands north of the Bigley farm.

The Freeport Upper coal is opened at a bank owned by Mr. Jacob Wilhelm and situated about three miles northeast from Fairmount. One measurement of the coal is illustrated by Fig. 45, reading as follows:

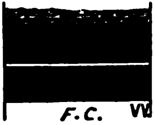
§ *263. Wilhelm coal bank.*

Slaty shale roof.

Slaty coal, ...	4″	4′ 4″
Coal, ...	2′ 0″	
Bony sulphur band, ...	2″	
Coal, ...	1′ 10″	

Fireclay floor.

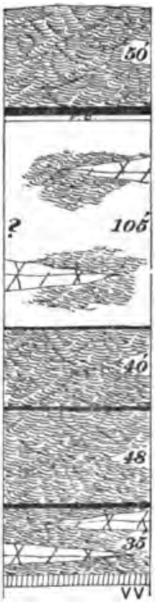
45.



This coal contains no persistent parting, but occasionally, as at the place where the above measurement was taken, sporadic lenticular disks of bone, sulphur and slate are distributed through the bed. The entry is driven in southwardly and drains itself. About fifty feet of overlying measures insure the presence of good hard coal. Mr. Hulmes has also opened a bank on this bed.

A section of two hundred and ninety-five feet compiled from exposures near these banks is shown by the accompanying Fig. 46.

46



§ *264. Section northeast of Fairmount.*

Surface, shale, ...	50′
Freeport Upper coal, ...	4′
Fireclay, ...	3′
Concealed; sandstone and shale, .	105′
Kittanning Upper coal, . . 1′ 1″ to	1′ 2″
Shale, ...	40′
Kittanning Middle coal, ...	1′ 3″
Fireclay, ... Shale, ...	48′
Kittanning Lower coal, ...	2′ 6″
Shale and sandstone, ...	35′
Ferriferous limestone, ...	5′

The Freeport Lower coal has not been opened in this vicinity. It is probably very thin.

§ 265. *The Kittanning Upper coal* has been dug into by Mr. Huffman who reports finding it thirteen or fourteen inches thick. The Kittanning Middle coal was mined some years ago at several places but being only from fifteen to eighteen inches thick was soon abandoned.

§ 266. *The Kittanning Lower coal* is opened and mined on Mr. Huffman's farm. It averages about two feet and six inches of good coal with a few inches of slaty coal on top, but contains no parting layers of slate or bone. The bed here has a sharp dip westwardly towards the Fairmount synclinal trough. Though this opening has been made quite recently and consequently is only a short distance in the hill, the coal is hard, bright and clean. The same bed has been mined for many years from several banks in this neighborhood, but these have all fallen shut. The bed lies two or three feet above water level.

§ 267. The *Ferriferous limestone* is opened up and quarried by Mr. Shick in the hollow below Mr. Hulme's place. It lies at water level. The Kittanning Lower coal is about thirty-five feet above the stream at this quarry.

§ 268. The Kittanning Lower coal is mined at McKillip's place one mile northeast from Mr. Hulme's farm at a bank opened at water level. It here averages about three feet of bright clean workable coal containing very little sulphur or slate.

§ 269. A beautiful farming country is passed through in driving up Pine run from Millville to Shannondale. The hillsides are occupied by the rather sandy and somewhat calcareous shales of the Clarion and Kittanning groups which by disintegration from an excellent warm soil quite free from those areas of cold clayey earth that in so many localities render the Clarion county lands almost worthless for agricultural purposes. Wheat, corn, oats, and garden truck are grown on these lands with good success.

The summits are capped by the Freeport Lower sandstone; a rather friable and shaly rock forming rounded knob hilltops. All the side-hills are beautifully terraced and benched by the Kittanning Middle and Lower coals and Ferriferous limestone.

§ 270. *Pine run* flows in the shales overlying the Homewood sandstone for a distance of two and a half miles below Shannondale, when it gradually begins cutting down into that rock. From this it will be noticed that the stream falls in its southwesterly course a little faster than the rocks dip.* At Millville the Homewood sandstone is about fifty feet above stream level.

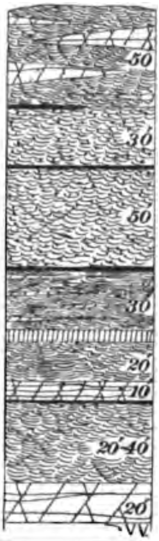
§ 271. *The Kittanning Lower coal* has been opened and mined at many places along the valley of Pine run, especially at and near Shannondale. It ranges from two feet and two inches up to three feet four inches in thickness; furnishes a good, hard, pitchy coal, admirably adapted to the ordinary requirements of household use. At Mr. Peter Greenawalt's opening near the Jefferson county line, the bed measures variably from two feet two to two feet four inches; contains no slate partings and and very little sulphur. It lies about thirty feet above the limestone, which has been opened up and quarried on the adjoining farms.

§ 272. *The Kittanning Middle coal* lies in the hill fifty feet above the Kittanning Lower coal, and is easily located by the bench already mentioned. It is quite thin.

§ 273. *The Kittanning Upper coal* was not seen in this neighborhood nor could any trace of its existence be detected.

A short distance south of Shannondale we find the succession illustrated by Fig. 47.

47.



§ *274. Shannondale Section.*

Freeport Lower sandstone, with some shale, in summits,		50′
Kittanning Upper coal, not seen.		
Shale, sandy,		30′
Kittanning Middle coal,	1′ 6″ to	2′
Fireclay, Shale, sandy,	about	50′
Kittanning Lower coal,		2′ 6″
Fireclay, Shale, with some thin-bedded S. S.,		30′

---

* The dip so estimated must not be taken as the true rate of dip into the Fairmount basin, for the direction of *true dip* is nearly west at this point and approximates seventy-five feet per mile.

Ferriferous limestone (seen 3'),	6'
Shales, soft,	20'
Sandstone, shaly,	10'
Clarion (Lower) coal,	1' to 2'
Shale, soft (variable),	20' to 40'
Homewood sandstone,	more than 20'
Total,	252'

Two miles below Shannondale the Ferriferous limestone lies only fifty feet above the Homewood sandstone; but at Shannodale there must be at least seventy feet of measures between these two rocks.

§ 275. *The Clarion (Lower) coal* has been opened at a few places but most of these have fallen shut and cannot now be examined. Nearly all the coal mined in this vicinity is taken from the Kittanning Lower bed.

§ 276. There are a large number of openings on the *Ferriferous limestone* between Millville and Shannondale. It is constantly accessible along Pine river and its tributaries, but sinks beneath water level much sooner along those streams coming in from the west than those flowing from the east. Its thickness varies from four to seven feet; its quality is good, but the overlying Ore-bed when present is quite thin and has been mined very little.

§ 277. *The Kittanning Lower coal* is opened up and mined at a bank owned by Mr. Songer and situated on his farm east of Shannondale. It averages from three feet to three feet four inches with no persistent parting of slate or bone; is a good coal and is much esteemed by those who use it for household purposes. An analysis made by Mr. McCreath from an average sample of the "run of the mine" gave:

	No. 15.
Water,	1.020
Volatile matter,	40.425
Fixed carbon,	47.511
Sulphur,	3.789
Ash,	7.255
	100.000

Coke, per cent.,	58.555
Color of ash,	reddish-grey.
Fuel ratio,	1:1.17

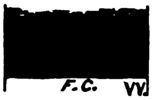
"Lustre dull black; considerably coated with iron oxide. Pyrites present in very minute crystals." This analysis shows an unlooked for percentage of sulphur: the amount of ash is also rather large; but on the whole the bed is as good as at Fairmount. (See § 260.)

One measurement of this coal gave the following thickness, illustrated by Fig. 48. The coal dips toward the southwest draining the bank without deep ditching.

§ 278. *Songer's coal bank.*

Slate roof.
Coal, ... 3′ 1″
Fireclay floor.

48.



Mr. Songer has opened a quarry on the Ferriferous limestone from which a considerable quantity of stone has already been taken. The bed here measures about five feet.

At the bank owned and worked by Mr. Solomon Barkhouse the *Kittanning Lower coal* ranges from two and a half to three feet.

§ 279. About one mile and a half west from Shannondale Mr. David Kunselman has opened up a six foot bed of coal. It lies near the hill-top with very little cover. Its identification with either the Upper or Lower Freeport coal is very uncertain. One mile northwest from Shannondale Mr. Reinzel has opened up the *Kittanning Lower coal* at a bank which lies nearly at stream level. About three feet of good coal is in sight.

Three fourths of a mile further up the run are several old diggings on the *Kittanning Middle coal.* They lie some distance above stream level. The bed is quite thin and did not pay to mine.

§ 280. At Mr. Clinger's near the north line of the township, and four miles northwest from Shannondale, *the Freeport Lower limestone* has been dug at an elevation of about one hundred and ninety feet above stream level. It is reported as from three to four feet thick; bedded like "flagstone," and is of very inferior quality. *The Ferriferous limestone* is here opened in the bed of the run. From this point down to the mouth of Town run at Fairmount, this limestone is constantly accessible. Its maximum height above the stream is attained near Truitt's store where it lies about forty feet above water level.

§ 281. *The Kittanning Lower coal* has been opened up and worked at a large number of openings scattered along the valley of Town run from Clinger's to Red Bank creek. In the neighborhood of Truitts, five banks are now in running order on this coal, and besides these there are several old banks now fallen shut. The bed ordinarily ranges from three feet to three feet and nine inches, but sometimes swells to nearly six feet; it contains no persistent parting, and few sulphurous laminæ, but the uppermost four or five inches is generally rather slaty. The roof is variable—sometimes sandstone, but usually rather soft, sandy shale. It lies about thirty feet, more or less, above the Ferriferous limestone.

§ 282. *The Kittanning Middle coal* was opened up some years ago by Mr. John Hilliard, but was found too thin to mine. It probably averages about two feet of workable coal.

§ 283. *The Clarion Lower coal bed* comes above water level at Truitt's, but soon descends again beneath the stream bed. This apparent rise is not due to an actual flexure crossing the measures at this point, but to a more rapid erosion of the stream, combined with a steepening of the dip. The union of the two branches of Town run just above this point is the probable cause of this augmented erosion. The Clarion (Lower) coal, where exposed near Truitt's, is only twenty inches thick, but is said to furnish an excellent blacksmithing coal.

§ 284. *The Ferriferous limestone* ranges from four to seven feet at its exposures along Town run, but as its base is seldom exposed its exact thickness can rarely be determined. At Mr. Geo. Frazier's quarries it is underlaid by a very pretty fine-grained flaggy sandstone. The limestone here measures seven feet and carries on top disconnected masses of outcrop ore, the remains of a bed apparently one foot thick.

The Freeport Lower limestone has been dug at Truitt's, but not being as pure as the Ferriferous limestone is not now worked. It lies ten feet beneath the Freeport Lower coal, which is easily located from its bold broad terrace.

§ 285. At Millville the sharp west dip into the *Fairmount basin* soon submerges the Homewood sandstone below water level in Red Bank creek, and eventually brings the *Ferriferous limestone* down to the same level.

The Millville test oil well commenced drilling on the flat at the mouth of Town run, at an elevation of from three to ten feet above the Ferriferous limestone, which is exposed at some old quarries situated in the bed of the run about three hundred feet, more or less, from the well mouth. The following record of this well has been taken from Mr. Carll's collection of oil well records, and will be discussed in his forthcoming Report I.I.I.

§ *286. Midland well, No. 1.*

Drilled in August, 1876, on the Jacob Brinker farm, half a mile east of Fairmount. Duplicate of section compiled by Mr. A. B. Howland, from a sectional drawing of the original record now held by Col. Jos. D. Potts:

Well mouth above ocean, in feet, about				**1080**
Conductor;		**8 to**	**8=**	**1072**
Limestone, (Ferriferous,)		**2 to**	**10=**	**1070**
Coal seam under limestone,	**(?)**	**1 to**	**11=**	**1069**
Black sand,		**18 to**	**29=**	**1051**
Coal,		**3 to**	**32=**	**1048**
Black sand,		**4 to**	**36=**	**1044**
Slate,		**40 to**	**76=**	**1004**
Shells,		**2 to**	**78=**	**1002**
Slate,		**33 to**	**111=**	**969**
Sand; white,		**3 to**	**114=**	**966**
Slate,		**32 to**	**146=**	**934**
Coal,	**Mercer Group ?**	**1 to**	**147=**	**933**
Slate,		**4 to**	**151=**	**929**
Coal,		**2 to**	**153=**	**927**
Slate,		**17 to**	**170=**	**910**
Coal,		**4 to**	**174=**	**906**
Slate,		**44 to**	**218=**	**862**
Sand; gray,		**10 to**	**228=**	**852**
Slate,		**2 to**	**230=**	**850**

Sand; white,	57 to 287=	793
Slate,	24 to 311=	769
Mountain sandstone,	251 to 562=	518
Red rock,	15 to 577=	503
Sand; white,	10 to 587=	493
Shelly slate,	75 to 662=	418
Sand; white,—gas,	20 to 682=	398
Slate with shells,	128 to 810=	270
Pebble shell,	1 to 811=	269
Slate,	10 to 821=	259
Shell; white,	5 to 826=	254
Slate,	12 to 838=	242
Sand; pebble,	10 to 848=	232
Slate,	8 to 856=	224
Sand; white,	14 to 870=	210
Slate,	2 to 872=	208
Sand; white,	80 to 952=	128
Sand; grey,	20 to 972=	108
Sand and slate,	18 to 990=	90
Red rock,	5 to 995=	85
Slate; shelly,	135 to 1130=	— 50
Red rock,	22 to 1152=	— 72
Grey slate and shell,	33 to 1185=	— 105
Slate,	11 to 1196=	— 116
Red rock,	4 to 1200=	— 120
Slate; shelly,	10 to 1210=	— 130
Red rock,	43 to 1253=	— 173
Shell,	1 to 1254=	— 174
Slate,	30 to 1284=	— 204
Shells and slate,	24 to 1308=	— 228
Shell,	3 to 1311=	— 231
Red rock,	5 to 1316=	— 236
Slate; shelly,	7 to 1323=	— 243
Sand,	9 to 1332=	— 252
Slate,	8 to 1340=	— 260
Shells and slate,	10 to 1350=	— 270
Sand,	5 to 1355=	— 275
Slate; shelly,	40 to 1395=	— 315
Red rock,	45 to 1440=	— 360
Red mud,	5 to 1445=	— 365
Slate; blue,	105 to 1550=	— 470
Red rock,	60 to 1610=	— 530
Blue slate and shells,	100 to 1710=	— 630
Red rock; very pale,	5 to 1715=	— 635
Blue slate and shell,	10 to 1725=	— 645
Sand; grey,	40 to 1765=	— 685
Blue slate and shells, streaks of red,	110 to 1875=	— 795
Sand; grey. Oil and gas show,	45 to 1920=	— 840
Slate; blue,	30 to 1950=	— 870
Sand shell, light grey,	4 to 1954=	— 874
Blue slate and shells.	56 to 2010=	— 930

Pebble shell,	1	to 2011	= — 931
Slate and shells,	21	to 2032	= — 952
Grey shell,	4	to 2036	= — 956
Blue slate and shells,	27	to 2063	= — 983
Sand shell,	6	to 2069	= — 989
Blue slate and shells,	39	to 2108	= —1028
Sand; white,	10	to 2118	= —1038
Blue slate,	4	to 2122	= —1042
Pebble shell,	2	to 2124	= —1044
Blue slate and shells,	42	to 2166	= —1086
Sand,—gas and oil show,	60	to 2226	= —1146
Blue slate,*	22	to 2248	= —1168
Interval to bottom of well,	32	to 2280	= —1200

* "Sand shell below this slate struck Saturday, A. M., 25th inst., thickness not given. Drilling in slate below this shell. Depth about 2270 feet, August 28, 1876."

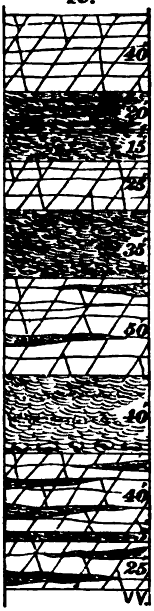
The coal noted immediately beneath the Ferriferous limestone is evidently a thin local deposit of bituminous matter continuous with the bed of shale discolored by infiltrated bituminous matter that is exposed in the Red Bank creek bed above Fairmount. In one copy of this record it is reported as a "trace of coal." In any case it can have no possible connection with the Clarion Upper (Scrubgrass) coal, for we are here *south* of the split Clarion coal (see Chapter 4,) and the Scrubgrass bed has no existence on this side of the bifurcation.

The Clarion coal was struck at 29 feet and is reported as three feet thick. It lies unusually close to the Ferriferous limestone. The "coals" noted at 147′, 151′, and 170′ in the record are undoubtedly the same with those beds of bituminous shale exposed along the railroad in cuttings west of New Bethlehem. They occur at and below the Mercer group horizon. The base of the conglomerate measures is probably on the 24 ft. of slate at a depth of 311 ft. in the well; the "Mountain Sand" must then be part of the Pocono, No. X. The red band noted at 577 feet can be nothing more than a red layer of the upper Pocono. The occurrence of the red at this horizon is very rare.

§ 287. The exposures of rocks underlying the coal measures are very poor. The exposures noted near Patton's station, where the Mauch Chunk red shale is exposed at railroad level, give the following succession (Fig. 49):

Section at Patton Station:

49.



Coal measures.	
Homewood sandstone, hard and massive,	40′
Shale, with streaks of coal,	20′
Ore bed,	1′
Shale,	15′
Sandstone,	25′
Shale, with kidney ore,	35′
Sandstone and shale,	50′
Shale, some sandy layers, ore balls,	40′
Sandstone, with some interbedded shale,	40′
Mauch Chunk red shale (seen),	5′
Shale and sandstone to stream level,	25′

The ore beds noted in the above section are thin and comparatively valueless. They are not worked. A partial record of the well drilled for oil at Brookville shows the existence of *red rock* at about the same horizon with the above noted stratum. The record is partly from memory and therefore is not as reliable as might be desired, but as no data are absolutely valueless to the scientist the record is reproduced as given from the driller's notes.

§ *288. Brookville Well.*

Drilled in 1875, on land owned by Mr. R. D. Taylor. Authority, Mr. R. J. Nicholson.

Conductor,	**23 to 23**
Mountain sandstone,	**120 to 143**
“RED SAND” or “RED ROCK,”	**15 to 158**
Soapstone and shale,	**20 to 178**
White slate,	**6 to 184**
Coarse sand,	**30 to 214**
Slate sand and red rock,	**161 to 375**
Interval,	**5 to 380**
First sand (gas show),	**29 to 409**
Soft rock,	**121 to 530**
Sand, with oil show,	**18 to 548**
Slate and shells (gas),	**92 to 640**
RED ROCK and shale,	**123 to 763**
Sand (gas, no oil),	**20 to 783**
Alternating slate, shale, and *red rock*, with shells,	**347 to 1130**

Sand, fine and close,	270 to 1400
Shale, slate, and red rock,	
Shale and slate,	300 to 1700

Cased in slate at 455′. "Had cased unsuccessfully several times before." The well mouth is situated about one hundred and twenty-five or fifty feet below the top of the Homewood sandstone.

Perry Township.

§ 289. This township lies north and west of Toby township, east of Armstrong county from which it is separated by the Allegheny river, and south of the Clarion river which parts it from Richland township.

A high ridge taking its course southeastwardly through the township from the mouth of the Clarion river merges with a similar divide coming northeastwardly from Monterey becomes the Clarion-Red Bank divide.

§ 290. *The Freeport group* of coals, limestones and ores is caught in the summits along these dividing ridges, but its area is necessarily very circumscribed. The Kittanning group of coals occupies most of the land, but the area covered by the Clarion group is also of considerable size. The Ferriferous limestone presents many miles of outcrop line, but its overlying ore-bed is thin and is only valuable over a very limited area. It has not been mined to any very great extent.

§ 291. *The ore beds* lying in the shales subjacent to the *Homewood sandstone* have been mined for use in Black Fox furnace but the workings were not extensive. This ore deposit occurs in "pots" or patches of good local development but it is not to be relied upon as a persistent bed. The same seams were also mined to some extent in Beaver township, and also in Butler county on Bear creek where they are now being re-opened for working by Major Mobley who has kindly furnished the following analyses which were made for him by Dr. Otto Worth:

	A.	*B.*
Silicic acid,	7.53	10.18
Aluminum sesquioxide,	2.17	4.26
Carbonate of iron,	86.61	78.72
Carbonate of lime,	2.05	3.91
Carbonate of magnesia,	.79	1.91
Manganese,	.43	.64
Phosphoric acid,	.34	.27
Sulphuric acid,	.08	.11
Metallic iron,	41.81	37.81
Phosphorus,	.148	.118
Roasted ore, Iron,	60 per cent.±	50 per cent.±

A, Bear Creek Upper vein at Donnelly station, about forty feet above the lower seam.

B, Bear Creek Lower vein at Donnelly station.

These ore beds are extremely variable in thickness. The ore often lies not in a regular bed but distributed in layers through several feet of shale, or again it may occur as ball ore scattered through a bluish, shaly slate.

§ 292. The hillslopes facing the Allegheny river and also those bordering on the Clarion are very abrupt. The lowermost two hundred feet is markedly steeper than the upper slopes. This is principally due to the lithological difference between the coal measure strata and the rocks of the Conglomerate series, but in some places it is to be referred to an oscillation of the river from side to side in its valley prior to its cutting down into the Conglomerate measures. As already shown in Chapter 3, this change took place at about the time when the river abandoned its old channel opposite Parker, to wit: at the close of or during the glacial period. As a description of this ancient water-course has already been given in that chapter, it is needless to say anything further concerning it. The drift there preserved is duplicated at many points along the Allegheny valley and is also found in a few of the side ravines. An instance of this is seen near the old furnace on Wildcat run, where the ravine is thoroughly choked up with drift which the stream is now unable to remove. The Allegheny at one time evidently ran in a sharp bend far up over the present site of the run, and in receding left the deposit with which it is now filled.

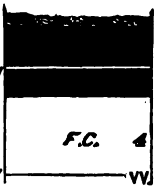
§ 293. *The first oil wells* drilled in Clarion county were located in this township, along the Allegheny valley opposite Parker. The territory thus far developed includes only a very narrow strip of land running northeast in a curved line from a point on the river below Parker to the Clarion river near the mouth of Turkey run.

§ 294. *The Clarion Lower coal* is opened and mined at a bank owned by Putney Bros. situated in the oblong hill enclosed by the ancient water channel near Perryville. The main entry has been driven into the hill about two hundred and seventy-five feet. An accurate measurement could not be made of the distance by which this coal underlies the Ferriferous limestone, but it seems to lie abnormally close to that rock. One measurement of the bed made near the pit-mouth gave the structure shown by Fig. 50. It furnishes a good, hard, free burning coal, though extremely sulphurous, and finds a ready sale for use under the oil well boilers:

§ 295. *Putney coal bank.*

Shale roof.		
Coal,	11″	3′ 7″
Bone,	1″	
Coal,	1′ 0″	
Bone,	1″ to 2″	
Coal,	1′ 5″	
Fireclay floor, (seen,)		4′ 0″

50



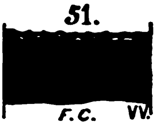
The Ferriferous limestone has been opened up and quarried on the adjoining farm. Its total thickness could not be ascertained, but those who have worked it estimate it at from twelve to sixteen feet.

§ 296. *The Clarion Upper coal* is opened and mined on the farm owned by Mr. L. Switzer a short distance east from Matildaville. Water lying in the entry at the time of examination hid its base from view. Figure 51 shows the measurement then made:

§ *297. Switzer coal bank.*

Shale roof.		
Coal,—semi-cannel,	7″	3′ 1″
Coal, (seen,)	2′ 6″	
Fireclay floor.		

51.



The occurrence of *cannel coal* at this horizon is not only rare but unique. The bed furnishes a good non-pyritous coal. Its roof is very soft shale and requires considerable timbering.

The Ferriferous limestone lies ten feet more or less above this coal, and is reported to measure fifteen feet. Its suprajacent ore bed is nearly one foot thick and has been largely mined for use in Madison and Prospect furnaces.

§ 298. *The Kittanning Lower coal* has been opened by Mr. Harrison Yingling at a bank situated a short distance east from West Freedom. The coal here lies about thirty feet above the Ferriferous limestone. It shows by measurement (Fig. 52):

§ *299. Yingling coal bank.*

Slate roof.		
Coal,	2′ 4″	2′ 10″
Slaty bone,	1″	
Coal,	5″	
Fireclay floor.		

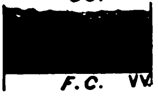
52.

It yields a fair though somewhat pyritous coal. Besides this bank there are several other banks in the immediate neighborhood in running order on this bed. At the McCall bank at West Freedom a large amount is taken out every year. The bed here shows (Fig. 53):

§ *300. McCall coal bank.*

Shale roof.	
Coal,	2′ 7″
Fireclay floor.	

53.



The bed here contains no persistent parting, is remarkably free from pyrites and yields only a moderate amount of ash. The entry is in most excellent condition and has been driven a considerable distance into the hillside, thus insuring good hard black coal. An average sample of this Kittanning Lower coal yielded on analysis by Mr. McCreath :-

	No. 33.
Water,	2.070
Volatile matter,	35.695
Fixed carbon,	55.275
Sulphur,	.830
Ash, (gray, red tinge,)	6.130
	100.000
Coke, per cent.,	62.235
Fuel ratio,	1:1.55

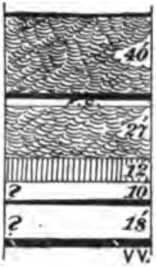
"Deep black, shining; brittle; shows a small amount of pyrites in minute crystals."

A section compiled from exposures near West Freedom is shown by figure 54, reading thus:

§ *301. West Freedom section:*

Kittanning Middle coal,	1′ 6″ to 2′
Fireclay, Shaly measures,	40′
Kittanning Lower coal,	2′ 10″ to 3′
Fireclay,	3′
Sandy shale,	27′
Ferriferous limestone,	12′
Concealed,	10′
Clarion Upper coal,	1′ 6″ to 2′
Concealed,	18′
Clarion Lower coal,	4′
Total,	121′

54.



The lower part of this section has been used in Page plate I, where it is drawn on an enlarged scale to show the split Clarion coal. (§ 113.)

The Kittanning Middle coal has been dug into by Mr. Yingling, but was never mined in this vicinity. It was passed through in a water well on the adjoining farm. This coal is seen in blossom at several places on the road leading south from West Freedom, but is always too thin to mine. The general character of its blossom indicates a twofoot seam.

The Kittanning Upper coal is not exposed near West Freedom. It is undoubtedly quite thin.

§ 302. *The Ferriferous limestone* is assigned a thickness of twelve feet in the above section, but in places it is reported to approximate a size of nearly twenty feet. Ten feet beneath it occurs *a thin coal seam* which is the same with the Parker and Martinsburg *Clarion Upper bed.* This section is the connecting link in the identification of this coal with the Scrubgrass coal, for it is here ten feet beneath the limestone, while at Parker the distance is fifteen feet, and at Martinsburg eighteen feet, and on the other hand it is only seven feet at Edenburg, and three or four feet down to zero, in Venango county.

The Clarion Lower coal has been opened and mined by stripping at water level, near West Freedom. It measures nearly four feet, but is extremely sulphurous.

§ 303. The high ridge south of West Freedom catches the *Freeport Upper limestone* and coal in two small roundtops; but as the coal has very little cover it is too soft to furnish good coal. *The Freeport Lower coal* was not seen in this neighborhood.

§ 304. *The Freeport Upper ore* has been dug quite extensively for use in Black Fox stripping. The drifts drive upon it were Furnace. It lies so near the summit that large areas were completely exhausted by necessarily very short.

The Freeport Upper coal, limestone, and iron ore, are all caught in the high knob on the Stewart farm. The ore here lies about eight feet beneath the limestone.

§ 305. Two miles south of West Freedom Mr. John Logan has opened up the *Freeport Upper bed,* and found three feet of good hard black coal. In the surrounding knobs it has very little cover.

At Mr. J. M. Reichert's quarry, on the Freeport Upper limestone, about five feet of the rock is laid bare. An average sample yielded an analysis by Mr. McCreath:

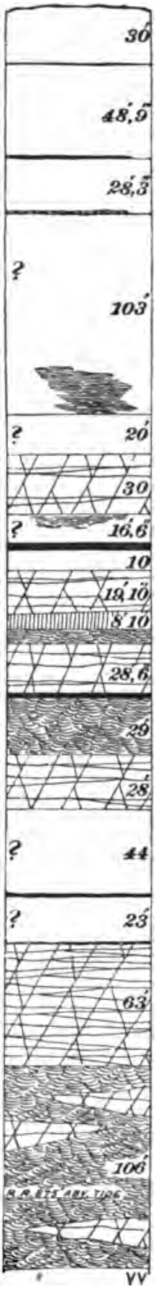
	No. 34.
Carbonate of lime, ...	82.678
Carbonate of magnesia, ...	8.248
Oxide of iron and alumina, ...	1.365
Phosphorus, ...	.022
Insoluble residue, ...	5.320

Miller's Eddy section.

The accompanying section, Fig. 55, has been re-drawn from a section at Miller's Eddy, compiled and kindly given to the Survey by Mr. John Haggerty, M. E., of Brady's Bend. It was made by instrumental leveling, and therefore may not show the exact intervals from coal to coal, as the variation caused by dip cannot be eliminated from a section so constructed without vitiating the integrity of the observed elevations. A description made from the hand draught reads:

Surface,	30′	
Coal, thin (Millerstown* bed,)	—	
Unnamed,	48′	9″
Freeport Upper(?) coal,	3′	
Unnamed,	28′	3″
Freeport Upper(?) ore,	? 2′	
Concealed with slate at bottom,	103′	
Kittanning Upper coal,	1′	6″
Unnamed,	20′	
Sandstone,	30′	
Unnamed,	16′	6″
Kittanning Lower coal,	3′	6″
Unnamed,	10′	
Sandstone,	19′	10″
Ferriferous limestone,	8′ to 10′	
Shales,	6′	
Sandstone,	28′	6″
Clarion coal,	2′	4″
Blue shales,	29′	
Sandstone, (Homewood ?)	28′	
Concealed,	44′	
Coal, (Mercer ?)	1′	
Unnamed,	23′	
Coal, (Mercer ?)	0′	9″
Flaggy sandstone,	63′	
Olive shales and sandstone,	106′	

55.



---

* For a description of this bed, also see report V, page 19.

"Rather fine-grained; mottled with calcite; dark pearl-grey."

§ 306. *The Freeport Upper Ore* is marked by a terrace of old workings fifteen feet below the limestone.

One mile and a half from Upper Hillville Mr. H. Snyder has opened up the *Kittanning Lower coal* at a bank where the bed shows the following structure (Fig. 56):

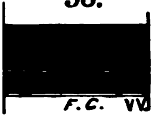
§ *307. Snyder coal bank:*

Slate roof.

Coal,	4 "	3' 10"
Soft parting,	½"	
Coal,	10"	
Slaty parting,	½"	
Coal,	1' 2 "	
Parting,	1 "	
Coal,	1' 2 "	
Slaty coal,	2 "	

Fireclay floor.

56.



The coal looks hard and good, but a careful examination discloses the presence of a large amount of pyrites.

§ 308. Ten feet of the upper layers of the *Ferriferous limestone* is exposed at the quarry owned by Mr. Phillip Barger. This opening is situated on a branch of Catfish run, one mile north from Upper Hillville. It lies twenty-five feet above the stream bed. An analysis made by Mr. McCreath of a sample from this quarry shows:

	No. 35.
Carbonate of lime,	96.428
Carbonate of magnesia,	1.202
Oxide of iron and alumina,	.867
Phosphorus,	.023
Insoluble residue,	1.110

"Rather coarse-grained; mottled with calcite; bluish-grey."

§ 309. *The Millerstown anticlinal* axis enters the township on the Allegheny river, about one mile above Upper Hillville, and passing northeast nearly parallel to the southeastern line of the township runs out into Licking township toward Callensburg. Its northwest dip can be detected in the coals and Ferriferous limestone on the headwaters of the streams flowing southwardly to Catfish run.

Licking Township.

§ 310. This is the only township of Clarion county consisting of two halves separated by the Clarion river. It lies north of Toby, east of Perry and Richland townships, south of Beaver and west of Piney township.

It is of irregular quadrilateral shape, averaging four miles in breadth and is about four miles long; roughly speaking it contains sixteen square miles.

Its principal streams are the Clarion river, Beaver creek, Cherry run and Licking creek. The latter runs around Callensburg in the old abandoned channel of the Clarion river which has already been described in Chapter 2. Cherry run now empties into it at Callensburg but at one time, prior to the abandonment of the old channel by the main stream, it emptied into the river.

§ 311. *The surface* of most of this township is planed off and leveled down to the Kittanning Middle coal horizon, leaving therefore about eighty to one hundred feet of measures above the Ferriferous limestone. There is much fair farming land especially south of the river and along the valley of Licking creek and near Easton.

§ 312. *The coal supply* is amply sufficient to meet the requirements of the resident population for an indefinite period, but the beds are too thin and their workable area too circumscribed for profitable shipping.

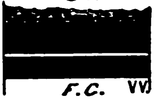
§ 313. *The Ferriferous limestone* and its suprajacent ore-bed present many miles of outcrop line. Both have been largely worked for use in Prospect and Buchanan furnaces. The ore ranges from six to fifteen inches, probably averaging nearly one foot.

The Brookville coal is opened and worked at a bank owned by Mrs. Elliot one mile east from Easton. A measurement of the bed gave this structure; illustrated by Fig. 57:

§ *314. Elliot coal bank.*

Draw slate,	3″	
Coal,	1′ 6″	2′ 8″
Binder, sulphury,	2″	
Coal,	1′ 0″	
Fireclay.		

57.



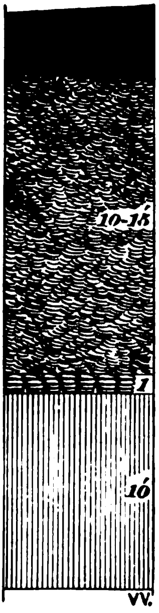
The upper and lower benches yield a very fair black and hard coal tolerably free from pyrites, but the two inch binder is very sulphurous and unless separated from the coal ruins it.

§ 315. The following section, shown by Fig. 58 was seen at Mr. David Frampton's place one mile southeast from Callensburg. It shows a remarkably small interval between the Kittanning Lower coal and the Ferriferous limestone, very unusual considering the geographical location; but in the northern and northeastern townships, and also at some localities directly east as at Sligo, this interval is frequently only eight or ten feet.

§ *316. Frampton Farm section:*

Kittanning Lower coal,	2′ 6″ to 3′ 10″
Shale, variable,	10′ to 15′
Ore,	1′
Ferriferous limestone,	10′

58.

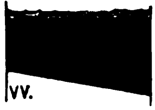


The Kittanning Lower coal is very variable, measuring two feet and six inches in one hill, and three feet ten inches in an entry on the opposite side of the run. This change is mainly due to a thickening of the lower bench, as shown in Fig. 59, of which the following is a description:

§ *317. Frampton coal bank:*

Slaty shale roof.
Coal, ... 1′ 0″ }
Binder, ... 1″ to 2″ } 2′ 7″ to 3′ 10″
Coal, ... 1′ 6″ to 2′ 8″ }

59.



The position of the one inch binder is very constant at about one foot below the top of the bed.

Mr. Frampton has opened a bed of ferruginous sandy shale with ore balls scattered through it, at an elevation of about twenty feet above water level. It is a comparatively worthless ore. Its geological position is rather low for the Mercer group, but it probably belongs to that series.

§ 318. Near Callensburg the country is much smoother, its general level lower, and the soil better than at any other locality along the Clarion river. This is due, 1st. To the shaly, loose-grained character of the conglomerate sand-rocks, and 2d. To the alteration in the course of the Clarion river, and the production, metaphorically speaking, of an island in its stream bed.

The outcrop of the *Ferriferous limestone* lies a long distance back from the river in the hills surrounding Callensburg.

§ 319. *The Millerstown anticlinal axis* runs nearly northeast through the township, passing close to Callensburg. This flexure may have had some agency in producing the now abandoned bend in the Clarion river at Callensburg.

Piney Township.

§ 320. This township is shaped like a truncated wedge; its apex pointing westward. It lies north and east of Toby, east of Licking, and east and south of Beaver township, from which it is separated by the Clarion river.

Piney creek, Licking, and Little Licking creeks are its principal streams. The valley of Piney creek is almost as sharply cut as the Clarion river gorge but the two forks of Licking creek flow in comparatively shallow valleys. These cut into and sometimes through the shales that here occupy the Mercer group horizon.

§ 321. As a rule there is little good *farming land* in this township, but in the neighborhood of Sligo some really excellent land is found which probably owes its superior quality to washings from the Ferriferous limestone.

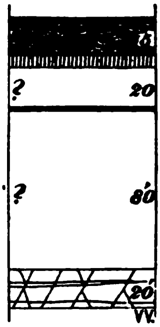
§ 322. *The Brady's Bend synclinal axis* runs northeastwardly through the township, passing a short distance east of Sligo. The Brady's Bend anticlinal just touches its southeastern corner. It keeps the Homewood sandstone far above water-level on Licking creek and its branches, so that at Curllsville in Monroe township, that stratum is nearly as high above the stream as at Sligo.

A section was compiled from exposures near Sligo. It is shown by Fig. 60, reading thus:

§ *323. Sligo section.*

Kittanning Lower coal,	3′
Fireclay, Shale,	15′
Ore,	0′ 10″
Ferriferous limestone,	7′
Concealed,	20′
Clarion coal,	2′
Concealed,	80′
Homewood sandstone,	20′
Total, (to water level,)	148′

60.



§ 324. *The Ferriferous limestone* here lies about one hundred and thirty feet above water level. Its outcrop line is marked by the old ore workings of Sligo furnace. These were most expensive along Anderson and Mineral runs. The ore ranges from a few inches up to two or even three feet in thickness, and carries in the shales above, more or less carbonate ball-ore, but its average size does not exceed ten inches. A considerable amount of ore has also been dug from the hills south of Sligo. An analysis of the limestone, by Mr. McCreath, reads:

	No. 20.
Carbonate of lime,	95.196
Carbonate of magnesia,	1.265
Oxide of iron and alumina,	1.529
Phosphorus,	.081
Insoluble residue,	1.780

"Fine-grained; rather tough; stained with ferric oxide; light bluish gray."

§ 325. Mr. McCreath has also analysed a sample of the ore used by the Sligo furnace, with the following result:

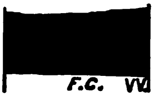
	No. 21.
Protoxide of iron,	44.357
Sesquioxide of iron,	2.857
Bisulphide of iron,	.109
Protoxide of manganese,	2.101
Protoxide of cobalt,	trace.
Alumina,	.743
Lime,	6.380
Magnesia,	2.248
Sulphuric acid,	trace.
Phosphoric acid,	.643
Carbonic acid,	33.333
Water,	1.789
Insoluble residue,	5.440
	100.000
Metallic iron,	36.550
Metallic manganese,	1.628
Sulphur,	.058
Phosphorus,	.281

"Specimen more or less oxidized; calc-spar in thin plates; somewhat cellular; bluish gray and reddish gray."

§ 326. *The Brookville coal* has been opened up at a bank one mile west from the mouth of Piney creek, but the opening has fallen shut, and the bed cannot be examined. It apparently contains from two and a half to three feet of coal, with a slate roof and fireclay floor, as shown by Fig. 61:

§ 327. *Beer's coal bank.*

61.



Slate roof.
Coal, ... 2′ 6″ to 3′ 0″
Fireclay.

The Burn's coal bank is opened on the Kittanning Lower coal. It has a soft shale roof which was in such dangerous condition that I considered it imprudent to enter the bank, and contented myself with an examination of the outcrop coal which measures about three feet and contains very little sulphur.

§ 328. The fireclay subjacent to this coal has been mined by stripping and used for the manufacture of firebrick. It has also been dug at several other localities in the township. An analysis by Mr. McCreath of the fireclay now used by the Sligo brick works shows:

	No. 19.
Silica,	56.630
Alumina,	28.850
Protoxide of iron,	1.260
Titanic acid,	.990
Lime,	.260
Magnesia,	.079
Alkalies,	.694
Water,	11.850
	100.000

This fireclay has been shipped to other brick works *via* the Sligo Branch and Allegheny Valley railroads and is highly esteemed by all who have used it.

§ 329. *The Kittanning Lower coal* has been mined at numerous old workings near Sligo but nearly all of these have fallen shut and the bed hid from sight. Many of these banks are re-opened and worked during the winter months.

An average sample of coke made from this coal in an open hive yielded on analysis by Mr. McCreath:

	No. 32.
Water,	2.090
Volatile matter,	2.826
Fixed carbon,	84.248
Sulphur,	1.764
Ash, (reddish-grey,)	9.072
	100.000

"Appearance rather dirty; structure very open; numerous partings of slate throughout specimens."

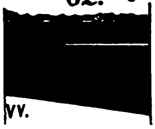
§ 330. This coal is opened at a large number of banks in the eastern part of the township where it ranges from three to four feet thick, with one parting of slate which usually occurs about one foot beneath the roof. At the bank owned and worked by Mr. Fox this Kittanning Lower coal shows the structure illustrated by Fig. 62, reading:

§ *331. Fox coal bank.*

Shale roof.

Coal,	1′ 0″	3′ 1″ to 4′ 2″
Parting,	1″ to 2″	
Coal,	2′ 0″ to 3′ 0″	

62.



This figure can be profitably compared with Fig. 59 of the Frampton coal bank. The position of the slate binder is the same in both banks.

The coal is hard, deep black and lustrous, with a moderate amount of sulphur and ash. An analysis made by Mr. McCreath from an average sample of this coal is appended below:

	No. 30.
Water,	1.470
Volatile matter,	41.355
Fixed carbon,	49.930
Sulphur,	2.070
Ash,	5.175
	100.000
Coke per cent.,	57.175
Fuel ratio,	1 : 1.21

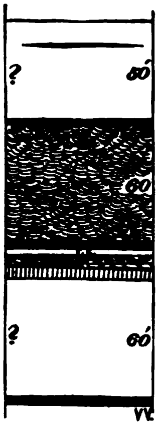
"Lustre deep black, shining; brittle; pyrites in minute crystals in partings." The sample from which this analysis was made contained none of the two inch parting. It was excluded because it can easily be removed in mining the coal.

§ 332. A section describing one hundred and ninety-seven feet of measures was compiled from exposures on Mr. Fox's farm. It shows a remarkably close approach of the Kittanning Lower coal and Ferriferous limestone. The Kittanning Middle and Upper coals are seen in blossom on the road. They are not mined.

§ 333. *Fox farm section* (Fig. 63):

Concealed (about),	10′	50′
Kittanning Upper coal (smut).		
Concealed (about),	40′	
Kittanning Middle coal,	3′	
Fireclay,		60′
Shale,		
Kittanning Lower coal,	4′	
Fireclay,	4′	8′
Shale, with ore balls,	4′	
Iron ore (in plates),	1′ to 3′	
Ferriferous limestone,	5′	
Concealed,	60′	
Brookville coal (reported),	4′	

63.



§ 334. *The Ore-bed* is unusually thick and remarkably pure. It lies in plates bedded very much like the subjacent limestone. The superjacent ball-ore was taken out with the shale, forming a variable increase to the output. An analysis made by Mr. McCreath from an average sample of this ore is given below. He describes the specimen as "very fine-grained; full of little pits partially filled with calc-spar. Rather hard and tough." It might be well to state that as a rule the quality of this carbonate ore can be judged by the relative coarseness or fineness of its molecular structure. Other things being equal, a fine-grained ore is always superior to a coarse-grained specimen.

	No. 31.
Protoxide of iron,	48.535
Sesquioxide of iron,	1.101
Bisulphide of iron,	.491
Protoxide of manganese,	1.282
Protoxide of cobalt,	trace.
Alumina,	.528
Lime,	5.650
Magnesia,	2.396
Sulphuric acid,	trace.
Phosphoric acid,	.277
Carbonic acid,	36.109
Water,	.711
Insoluble residue,	2.920
	100.000
Metallic iron,	38.750
Metallic manganese,	.994
Sulphur,	.262
Phosphorus,	.121

A large body of ore still remains in this hill, for mining had hardly fairly commenced when Sligo furnace was blown out, after which only a small quantity was taken out for use at Red Bank, and when that furnace was also blown out, mining operations were immediately stopped.

§ 335. Madison furnace is located on Piney creek, a short distance from the Clarion river.

The old ore workings of this stack can still be seen in the surrounding hills. An analysis of this ore as given in the report on the First Geological Survey is appended below. It was evidently made from roasted outcrop ore.

"Peroxide of iron,	76.10
Silicious matter,	7.70
Alumina,	3.60
Water,	12.50
	99.90
Metallic iron,	53.27"

"Dull brown, cellular, compact, burnt-stone ore."

A record of the Sligo well drilled in 1865 is here reprinted from Report I.I. to show what is now known of the underground rocks at this point. This record was originally published by Prof. Lesley in the proceedings of the American Philosophical Society in 1865.

§ *336. Sligo Well.*

On Licking creek in Piney township. Drilled August, 1865. Authority Lyon, Shorb & Co.

Well mouth above ocean in feet,	—		——	
Conductor,	15	to	15	=
Slate; (soft and light 22′, black 5′,)	27	to	42	=
Sandstone; hard,	7	to	49	=
Slate; soft and black,	6	to	55	=
Sandstone; hard,	7	to	62	=
Slate; shelly,	3	to	65	=
Coal,	2	to	67	=
Sandstone; (water at 128′,)	116	to	183	=
Slate; top hard, bottom soft,	85	to	268	=
RED ROCK; soft slate,	2	to	270	=
Sandstone; soft,	10	to	280	=
Slate,	90	to	370	=
Sandstone; close grained and blue,	20	to	390	=
Slate,	49	to	439	=
Sandstone; hard and blue,	27	to	466	=
Slate; soft "resembling fireclay,"	284	to	750	=
RED ROCK; soft slate,	5	to	755	=
Sandstone; hard,	10	to	765	=
Slate; blue,	21	to	786	=
RED ROCK; (slate,)	29	to	815	=
Slate; blue,	77	to	892	=
RED ROCK; (slate,)	3	to	895	=
Slate; brown,	30	to	925	=
Slate; hard and soft alternating, (oil,)	112	to	1037	=
Slate; blue and shelly,	14	to	1051	=
Sandstone; blue,	30	to	1081	=
Sandstone; blue and RED,	36	to	1117	=
Sandstone; white and hard,	11	to	1128	=
Sandstone; RED and white,	13	to	1141	=
Sandstone; blue and RED,	10	to	1151	=

Salt water at 128′, 380′, and 450′. No paying production. Well mouth below Ferriferous limestone ore-bed 173′. This elevation seems to be somewhat too great for at Sligo the Ferriferous limestone is only 135′ above water level; this discrepancy may be due to the strong south dip into the Brady's Bend synclinal trough which crosses Licking creek near Sligo.

Monroe Township.

§ 337. This township lies east of Piney, north of Porter and west of Limestone and Clarion townships. Its northern edge borders on the Clarion river which separates it from Paint township.

The Clarion group and *Conglomerate measures* form most of the land in its northern portion but further south the Kittanning group usually supplies the surface rock ; and the Freeport Lower sandstone is occasionally found in some of the higher knobs.

Brush creek, Piney creekand Licking creek, all of which drain into the Clarion, are its principal streams.

As a rule the *farming land* is of fair quality, but there is very little really good soil in the township, while on the other hand there is an abundance of despicably poor land.

§ 338. *The Brady's Bend synclinal* runs across the northwestern corner of the township passing out towards Clarion. It crosses Piney creek near the mouth of Brush run.

The Brady's Bend anticlinal lies about one and a half mile southeast from the synclinal axis. It elevates the Homewood sandstone at Curllsville and Reidsburg, passing close to both those towns. *The Lawsonham synclinal* axis is not well marked. It cuts across the southeastern corner of the township and running northeast passes out into Limestone township.

§ 339. *The Freeport Lower coal* is not found in this township. Some of the summits along the Clarion-Red Bank divide are capped by the Freeport Lower sandstone, but it is a soft, shaly rock, sometimes entirely replaced by sandy shale, and cannot be recognized by any marked topograpical features. Its identification is entirely based upon its height above the Ferriferous limestone.

§ 340. *The Kittanning Upper coal* was not seen within the township limits. It is evidently quite thin if not altogether absent. *The Kittanning Middle coal* is frequently exposed in blossom along the main roads, but the bed is not worked. Its smut indicates the presence of a two-foot seam. At one place where it has been opened up a thickness of three feet is reported.

§ 341. *The Kittanning Lower coal* has been opened up and mined at a bank on the Keifer estate, where the seam is said to measure three feet. A bad slate parting traverses the bed near its middle making the coal very dirty and almost valueless.

§ 342. *The Ferriferous limestone* varies from four to eight feet. It is now exposed at several places, but most of these quarries are partially filled with earth or water so that its thickness is seldom in sight. Its superposed ore has been dug and mined in large quantities for use at Madison, Monroe, Washington, and Sligo furnaces. It is rather unusually thick, averaging probably one foot and one or two inches, and is said to have been more highly esteemed than that from any adjoining township. In some places it was completely worked out from crop to crop, but here and there are a few tracts still remaining from which comparatively little has been taken. It lies at from one to two hundred feet above water level in the larger streams.

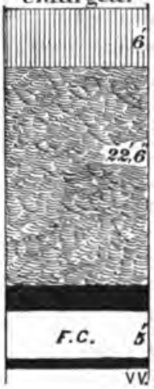
§ 343. A short distance south of Williamsburg Mr. Cribbs has opened a bed of coal which on the crop shows for a two and a half foot seam. It is evidently an extremely variable bed, as marked changes occur not only in the roof but also in the floor of the coal. Five feet below this a thin seam has been found which will probably measure somewhat over one foot. These two coals are the two *Clarion coal beds*, or rather, *the two benches* of the Clarion bed, here separated by only five feet, their structure in this respect somewhat resembling that on Bear creek in Butler county. Fig. 64 shows the relative position of these coals and their distance below the Ferriferous limestone. It can be compared with the sections shown on Plate I, and for this purpose has been drawn on the same scale as those sections, viz, 20′ to 1″. Such a comparison developes several noteworthy features to which a reference is not out of place:

1st. *The Clarion Upper coal* is here the best bench whereas at Parker, Martinsburg, and in northern Clarion county and Venango county the *lower bench* is usually the thickest, and

2d. *The Clarion Lower coal* exists in a remarkably attenuated condition, whereas it is usually a two or three foot seam.

§ *344. Cribbs farm section:*

64.
enlarged.



Ferriferous limestone, ...	6′
Shale, ...	22′ 6″
Clarion Upper coal, ...	2′ 6″
Fireclay, ...	5′
Clarion Lower coal, ...	1′

The horizon of the Ferriferous limestone was determined by the site of old diggings upon it in an adjoining field.

§ 345. *The Brookville coal* is not opened in this township. It is an inferior bed, and though often three feet thick is too slaty and sulphurous to mine.

§ 346. The sandrocks underlying the Homewood sandstone are very hard and massive along the Clarion river gorge, bluffing out in bold, often perpendicular escarpments and covering the slopes below with large, scattered blocks.

Limestone Township.

§ 347. This lies directly east of Monroe, north of Porter and Red Bank townships and south of Clarion township, its eastern edge in juxtaposition with Jefferson county. It is an almost perfect parallelogram with sides respectively five and a half and nine and a half miles long.

Piney creek and its branches drain nearly all the township. Through most of its course it flows in the Connoquenessing sandstone horizon.

§ 348. Much excellent *farming land* is found at many localities, especially where the slopes are gentle and the Ferriferous limestone outcrop broad. As its name indicates the township is well supplied with *limestone*, which frequently has been opened up and quarried.

The summits are usually capped with more or less of the *Kittanning group* of coals which occupies an area about equal to that covered by the *Clarion group.*

§ 349. *The Homewood sandstone* is often laid bare along the tributaries to Piney creek. It is sometimes a hard, massive, and thick escarpment forming stratum, but again is a soft, friable, and shaly rock. Thin, impure *coal seams* have been found in the shales below, but they are always nearly or altogether valueless.

A few oil wells have been unsuccessfully drilled within the township limits, but unfortunately no records of them could be obtained; probably none were kept.

§ 350. *Three synclinal* and *two anticlinal* axes traverse the township from southwest to northeast on an average course of from N. 35° E. to N. 40° E. *The Lawsonham synclinal* cuts across its northwestern corner. *The Kellersburg anticlinal* passes through Greenville from the southwest corner to the middle of Clarion township south line. *The Centreville synclinal* though named from Centreville in Armstrong county by a happy coincidence passes very close to the Centreville P. O. in this township. *The Anthony's Bend anticlinal* passes out of the township near Corsica and the *Fairmount synclinal* just touches the southeast corner of the township.

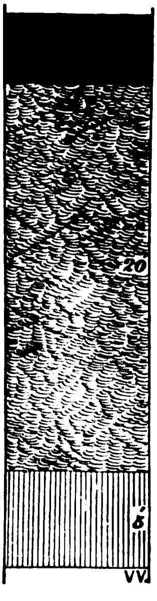
None of these axes excepting the Fairmount synclinal trough are marked by sharp north or south dips, and they can only be traced with great difficulty.

A section compiled from exposures near Mr. Sloan's house, one mile and a half south from Greenville is shown by Fig. 65 reading:

§ *351. Sloan farm section:*

Kittanning Lower coal, ...	3′ 6″
Shales, partly concealed, ...	20′
Ferriferous limestone, ...	5′

65.



The Ferriferous limestone has been opened, but its full thickness is not exposed.

§ 352. *The Kittanning Lower coal* has been largely mined at Mr. Sloan's opening. The main entry of this bank lies in the trough of a well marked synclinal,—the Centreville axis,—by which its drainage is greatly facilitated.

§ 353. An analysis of this coal, by Mr. McCreath, shows:

	No. 36.
Water,	1.750
Volatile matter,	36.440
Fixed carbon,	55.438
Sulphur,	1.072
Ash, (reddish-gray,)	5.300
	100.000
Coke, per cent.,	61.810
Fuel ratio,	1:1.52

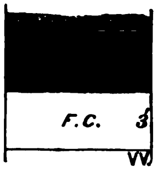
"Deep black, somewhat iridescent; laminæ rather indistinct; somewhat coated with iron oxide."

The bed is unusually thick, contains no slate partings, and only one thin pyrite band, has a good strong roof, and presents a large area thus far untouched. One measurement of the bed made near the pit-mouth is illustrated by Fig. 66:

§ *354. Sloan coal bank.*

Slate roof.		
Coal,	5 ″	3′ 5¾″
Pyrite band,	½″ to ¾″	
Coal,	3′ 0 ″	
Fireclay floor.		

66.



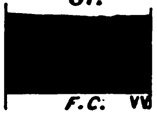
§ 355. *The Kittanning Lower coal*, where opened by Mr. Riley, one mile south of Mechanicsville, measures about two and a half feet. It lies only a few feet above the Ferriferous limestone. The latter has been dug by Mr. Riley from an opening in the field just back of his house, at which four feet of the stone is exposed.

§ 356. At the bank owned by Mr. Stewart the *Kittanning Lower coal* has a poor slaty roof. A measurement of the bed is shown by Fig. 67. The slaty shales overlying this coal are full of iron balls, which show in their hollow interiors an abundance of siderite crystals, associated with calc-spar.

§ 357. *Stewart coal bank.*

Slaty roof; poor.
Coal, ... 3′ 6″
Fireclay floor.

67.



Clarion Township.

§ 358. This lies next east from Monroe and north of Limestone township with its eastern edge adjacent to Jefferson county. It is also bounded on the north and east by Mill creek which separates it from Mill Creek township, and on the north by the Clarion river parting it from Paint and Highland townships.

Its length, east and west, is about ten miles and its breadth varies from two to four miles, being least at the Jefferson county line.

§ 359. *The Kittanning group* of coals is found in some of the higher ridges, but most of the township is occupied by the outcropping Clarion group and the underlying sandy measures of the Conglomerate series.

Some moderately good *farming land* exists but as a rule the land is rather poor. This is probably in great measure owing to an absence of the Ferriferous limestone over large areas in which we would naturally expect to find it.

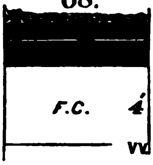
§ 360. The following axes cross the township:
Anthony's Bend anticlinal near Corsica,
Centreville synclinal,
Kellersburg anticlinal,
Lawsonham synclinal one mile and a half east of Strattonville,
Brady's Bend anticlinal, west of Strattonville,
Brady's Bend synclinal, east of Clarion.

§ 361. *The Kittanning Lower coal* has been opened up and mined at a bank owned by Mr. S. W. Fleming one mile west of Corsica. The opening is situated on the north side of the pike. A measurement of the bed is shown by Fig. 68:

§ *362. Fleming coal bank:*

Shale roof.		
Coal,	8″	2′ 0″
Slate,	1″	
Coal,	1′ 3″	
Fireclay floor, (seen,)		4′ 0″

68.



The coal is quite free from sulphur and mines in good hard pieces, but the bed is rather too thin for profitable working. It shows a *west dip* into the Centreville synclinal.

§ 363. *The Ferriferous limestone* is exposed at a quarry owned by Mr. Albert Hindman who reports about four feet of stone overlaid by five feet of ore bearing shale:

	No. 28.
Carbonate of lime,	95.532
Carbonate of magnesia,	.930
Oxide of iron and alumina,	1.050
Phosphorus,	.070
Insoluble residue,	1.960

The above analysis was made by Mr. McCreath from a sample of the limestone from Hindman's quarry. He describes it as being "fine-grained, mottled with calcite, rather brittle; bluish grey."

§ 364. An analysis of the carbonate ball ore from the same locality yielded:

	No. 29.
Protoxide of iron,	38.571
Sesquioxide of iron,	2.142
Bisulphide of iron,	.009
Protoxide of manganese,	1.756
Protoxide of cobalt,	trace.
Alumina,	1.027
Lime,	6.750
Magnesia,	1.992
Sulphuric acid,	trace.
Phosphoric acid,	2.333
Carbonic acid,	29.403

Water,	2.137
Insoluble residue,	13.880
	100.000
Metallic iron,	31.500
Metallic manganese,	1.361
Sulphur,	.005
Phosphorus,	1.019

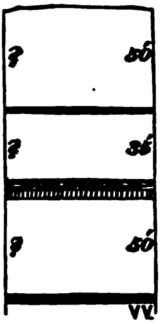
No. 29. "Hard and tough rather coarse grained; surface somewhat oxidized; bluish-grey."

§ 365. A section compiled near Corsica is shown by Fig. 69. It shows an interval of forty feet between the Ferriferous limestone and the Kittanning Lower coal. The Clarion coal was not exposed at this locality but the Brookville coal four feet thick has been laid bare by stripping on Mr. S. N. Albright's farm near the Hindman limestone quarry. A complete measurement of this coal was prevented by an accumulation of water in the diggings. It is a very sulphurous bed.

§ *366. Corsica section.*

Concealed in hilltops, (shale ?)	50′
Kittanning Lower coal,	2′
Concealed,	35′
Shale, with ore-balls,	5′
Ferriferous limestone,	4′
Concealed, (about)	50′
Brookville coal,	4′
Total,	150′

69.



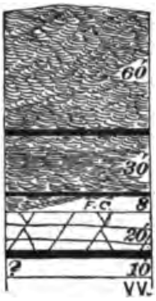
§ 367. From this locality westward to Clarion *the hilltops* are constantly high enough to catch detached areas of the *Ferriferous limestone*, but though diligent search has frequently been made, it has never been found. It is undoubtedly absent. This is shown by the near approach of the *Clarion* and *Kittanning Lower coals*, and by the character of the associate measures and of the resulting soil.

§ 368. A section compiled from exposures seen between Strattonville and Clarion is illustrated by Fig. 70. It shows an interval of only thirty feet between the Kittanning Lower and Clarion coal beds, whereas that interval is normally seventy feet and never less than forty-five feet when the Ferriferous limestone is present. Whether such absence of this limestone be due to *accidents of original deposition*, to *sub-aerial* erosion, or to *sub-aqueous* erosion by *solution* we cannot determine, but that this stratum is frequently wanting there can be no doubt.

§ *369. Section east of Clarion.*

Shale in hilltops, ...	60′
Kittanning Lower coal, ...	3′
Fireclay, ...	30′
Concealed shaly and slaty measures,	
Clarion (Lower) coal, ... 1′ 8″ to	2′
Fireclay and shale, ...	8′
Clarion sandstone, ...	20′
Brookville coal, ...	4′
Concealed to water level in run, . . .	10′
	137′

70.



The Kittanning Middle coal should be found in the uppermost sixty foot interval, but its smut could not be detected.

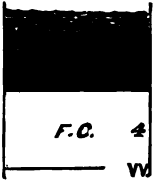
The Kittanning Lower coal is opened and worked at a bank owned by Mr. Samuel Young. The ventilation of this bank is very defective. In some places the air is so impure that a candle or an ordinary oil lamp will not burn, and turpentine has been substituted and used in open lamps in place of oil. Mining under such conditions is simply suicide and should not be permitted.

The bed yields a very fair coal quite free from sulphur. A measurement is shown by Fig. 71.

§ *370. Young coal bank:*

Draw slate, ...		8″
Coal, ...	10″	2′ 11″
Slate, ...	1″	
Coal, ...	2′ 0″	
Fireclay floor (more than), ...		4′ 0″

71.



§ 371. A well proven fault,—illustrated by page plate V,—traverses this coal bed near the lane leading south from the pike. A direct break of three feet which brought the floor of the coal in one part of the bank in direct continuation with the roof on the opposite side, was passed through in an old entry near the Young bank. At one place the broken edges overlapped so that for a distance of five feet the bed was double and furnished six feet of coal, in which a parting of six inches of slate was found adhering to the roof of the lower layer. In every case the edges were sharp well defined cross-breaks. This fault is situated on the Brady's Bend anticlinal crest, for the coal here dips southeast while at a bank a few hundred feet away it dips northwest into the Brady's Bend synclinal.

§ 372. *The Kittanning Lower coal* has been mined and shipped on the Narrow Gauge railroad by the Clarion Coal Company. Their mine is operated by a shaft which I did not enter because the bank was not running when visited. A sample of the coal from this pit forwarded to the laboratory by Mr. Greenland, manager for the company yielded by analysis; (McCreath):

	No. 37.
Water @ 225°,	2.060
Volatile matter,	38.075
Fixed carbon,	56.782
Sulphur,	.818
Ash (cream),	2.265
	100.000
Coke per cent.,	59.865
Fuel ratio,	1:1.49

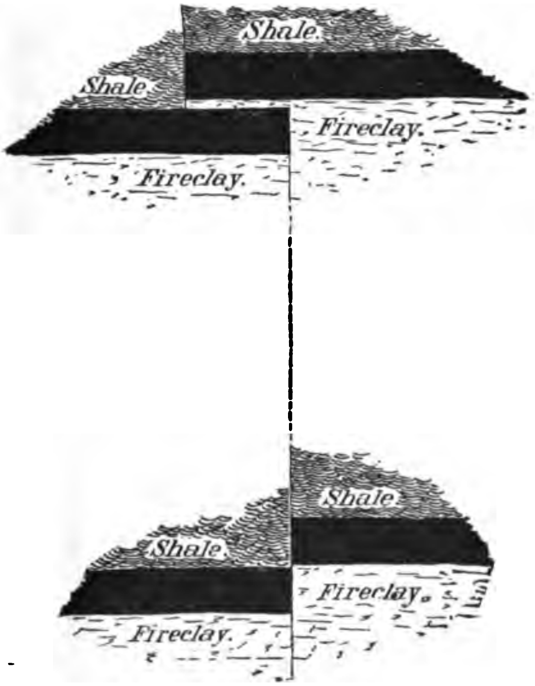
"Generally very compact; lustre deep black. Specimens seem in main free from pyrites and slate partings." This analysis speaks for itself.

§ 373. *The Clarion (Lower) coal* is only eighteen inches thick where exposed near the Young bank. It is not mined.

§ 374. *The Brookville coal* has been opened at several places. At the shaft owned by Mr. James Wilson the bed

Sections showing A Fault in the Kittanning Lower Coal near Strattonville, Clarion Co. Pa.

by H. Martyn Chance.



measures nearly four feet, but at Mr. Young's the coal is somewhat thinner. It is quite sulphurous.

A hard, massive sandstone (*Clarion sandstone*) fifteen or twenty feet thick lies immediately above this coal, making an excellent roof. This sandstone is always more or less friable, of pinkish or brownish hue, and always makes a very sandy soil. It can be seen at innumerable places along the pike between Corsica and Clarion, but in the other townships of Clarion county its horizon is *usually* occupied by shaly measures, excepting over those areas where the Homewood sandstone rises above its normal horizon and entirely cuts it out.

§ 375. *The Brookville coal* is also opened up at a bank one mile south by west from Clarion, where it is about three feet thick. An accurate measurement was prevented by dead water filling the bank. This opening is situated near the trough of the Brady's Bend synclinal. A strong north northwest dip was observed.

The Clarion sandstone is quite massive in this vicinity.

§ 376. In the report of the First Survey we find on page 569, Vol. II:

"At the county seat of Clarion the Clarion [*Lower*] coal bed lies 40 or 45 feet beneath the court-house. It has been opened at its outcrop upon the face of the hill overlooking the Clarion river. [These openings are all closed.] The bed is three feet thick, but yields coal too impure for common use, because of the sulphur and pyrites which it contains. Attempts . . to find the Brookville bed . . . were not attended with success. The latter coal is said to have been penetrated by a well sunk . . . . . near the court-house, at a distance of 30 or 40 feet below the upper coal. East of the town the lower [*Brookville*] coal was bored into several feet; and it is highly probable that the same bed may be found of workable size at Clarion, after it has been fairly entered beneath the hill."

Mill Creek Township.

§ 377. This lies northeast of Clarion township from which it is separated by Mill Creek. Its north and west edge borders on the Clarion river, which parts it from Highland and Farmington townships ; its east line borders on Jefferson county.

In shape it roughly approximates that of an equilateral triangle with sides about eight miles long.

§ 378. Nearly all the *surface* is occupied by the outcropping *Conglomerate measures*, and the land is correspondingly poor. The highest summits catch isolated patches of the Kittanning group and on some much lower ground the Clarion coal group is occasionally found.

In this as in Clarion township the *Clarion sandstone* forms prominent topographical features, thus furnishing a tolerably good and easily recognized geological horizon on which to base comparisons of sections. Our best horizon for this purpose is the Ferriferous limestone, but that stratum is absent from the measures of Mill Creek township.

§ 379. *Two anticlinal* and *two synclinal axes* pass through the township, namely, Centreville synclinal, Kellersburg axis, Lawsonham synclinal, and the Brady's Bend axis.

The Centreville synclinal cuts across the extreme southeastern corner of the township ; *the Kellersburg anticlinal* enters near the union of the two forks of Mill creek.

The Lawsonham synclinal runs through the centre of the township and it is in its trough that the high lands containing the Kittanning group occur. It passes close to Fisher's Corners. *The Brady's Bend anticlinal* runs along the eastern edge of the township, close to the Clarion river. The zigzag course of the river from Cooksburg to Strattonville is probably referable to the proximity of this axis.

§ 380. Nearly all the coal openings, most of the good land, and the highest summits are all close to the pike which runs through the centre of the township along the Lawsonham synclinal trough.

§ 381. *The ridge* between Terwilliger's hotel and Fisher P. O. (Dougherty's store) is high enough to contain the Kittanning Middle coal, but no trace of it could be found.

The Kittanning Lower coal is exposed in blossom at several places in this vicinity. It is not opened, and this is somewhat surprising for the blossom indicates a two and a half or three foot seam, and in the absence of any contra-indications it is safe to assume that its quality is good. Some years ago Mr. T. Dougherty opened up this bed and found nearly three feet of fair coal, but the bank was allowed to cave in.

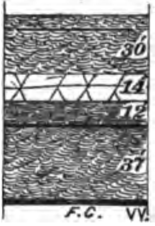
§ 382. *The Ferriferous limestone* and its superincumbent ore bed have never been found though diligent search has been made for them. The shales occupying its horizon are of the ferruginous character often worn by the shales overlying it.

Exposures noted near Mr. Terwilliger's hotel gave the section shown by Fig. 72.

§ *383. Mill Creek section:*

Sandy shale, Clarion coal at base,	30′
Clarion sandstone,	14′
Slate,	12′
Brookville (?) coal, reported in well.	
Shale,	37′
Coal (Mercer horizon ?),	2′ 6″
Fireclay.	

72.



The lowest coal noted in this section is mined by Mr. Wm. Ion. It lies sixty-five feet below the top of the Clarion sandstone and therefore seems too low to be the Brookville bed. A thin coal reported in a water-well near by seems to lie in the *Brookville* horizon, but it is still possible that this may be a thin local deposit and that the Ion bank is on the Brookville bed. These identifications are made difficult and their value greatly lessened by *the absence of the Ferriferous limestone* and the consequent changes in the intervals between adjacent coal beds.

§ 384. Mr. A. B. Miller has opened a bank on a coal underlying the Clarion sandstone which shows from two feet three to two feet seven inches of fair coal, with a slaty shale roof of which six or eight feet is exposed. This is probably the Brookville coal bed.

§ 385. Mr. D. Stallman has a bank on the *Brookville bed* which shows up about four feet of coal which however is of rather inferior quality. The bank owned by Mr. A. Underwood is opened on the Clarion coal bed.

§ 386. *Two test wells* have been drilled on Blyson run. One of these was drilled several years ago and is a comparatively shallow well. It is situated near the mouth of the run. The other is two miles from the river: being a recent venture was drilled very deep. A record of the rocks passed through is reproduced below from its original publication in Report I.I., page 232.

§ 387. *James Well.*

Drilled in 1872-3-4. Authority, Abram James. The well mouth is situated about more than 100 feet below the horizon of the Ferriferous limestone.

Well mouth above ocean in feet,		
Conductor,	25 to	25=
Sandstone (Sandstone) rotten; no limestone,	253 to	278=
Mt. Sandstone, white and gray (gas at 380'),	157 to	435=
Sandstone, gray (oil at 445' and 518'),	90 to	525=
Slate, blue,	135 to	660=
Sandstone, gray,	28 to	688=
Slate,	30 to	718=
Sandstone, gray,	12 to	730=
Slate, with shells of gray sandstone,	120 to	850=
Red rock (gas near bottom),	45 to	895=
Slate, black, hard and gritty,	5 to	900=
Sandstone, "bowlder," gray and gritty,	30 to	930=
Sandstone, "emery," fine and hard,	5 to	935=
Slate, black,	11 to	946=
Red rock,	5 to	951=
Slate, blue, with shells,	62 to	1013=
Red rock,	7 to	1020=
Slate, black, with gray shells; first salt water,	92 to	1112=
Shale, black and red; green sandstone near bottom,	13 to	1125=
Red sandstone,	4 to	1129=
Sandstone, gray (gas and oil show),	13 to	1142=
Sandstone, pebbly, dark gray,	11 to	1153=
Slate, with small "mustard seed" pebbles,	6 to	1159=
Sandstone, fine and light,	17 to	1176=

Slate, black, with white shells of sand,	29 to 1205=
Slate, blue and soft,	18 to 1223=
Sandstone, light gray and fine,	33 to 1256=
Red sandstone, very red,	20 to 1276=
Soapstone,	167 to 1443=
Slate, dark and gritty (gas),	20 to 1463=
Slate, light,	5 to 1468=
Slate, blue, with transparent pebbles,	10 to 1478=
Sandstone, gray and light gray,	21 to 1499=
Slate, dark,	17 to 1516=
Sandstone, light gray, hard,	27 to 1543=
Sandstone, white (gas and oil show),	2 to 1545=
Slate, light blue,	17 to 1562=
Sandstone, fine, dark gray (gas),	8 to 1570=
Shells of sandstone,	5 to 1575=
Sandstone, gray, coarser near bottom (gas),	30 to 1605=
Red rock, sand, fawn-colored, like paint (gas and oil show),	23 to 1628=
Soapstone, light and soft,	13 to 1641=
Sandstone, gray and white, with shells and slate,	45 to 1686=
Slate, clear white, no grit,	27 to 1713=
Red rock, hematite, very red,	6 to 1719=
Sandstone, "bowlder," fine,	15 to 1734=
Soapstone,	14 to 1748=
Sandstone, nearly white (gas and oil),	22 to 1770=
Slate, blue, "buckwheat batter,"	60 to 1830=
Sandstone, white,	2 to 1832=
Slate, gritty,	6 to 1838=
Sandstone, sharp and white,	4 to 1842=
Slate, white,	3 to 1845=
Sandstone (sandstone) . . . gas,	6 to 1851=
Slate, white,	28 to 1879=
Sandstone, hard,	2 to 1881=
Sandstone, coarser at bottom (gas and oil),	23 to 1904=
Shelly slate,	44 to 1948=
Slate, blue, free from grit,	49 to 1997=
Shelly slate,	43 to 2040=
Sandstone, fine (gas),	13 to 2053=
Shale, olive, free from grit,	10 to 2063=
Shale, olive, with brown shells (gas and oil),	49 to 2112=
Slate, light blue,	20 to 2132=
Soapstone, light brown,	20 to 2152=
Sandstone, white (large increase of gas),	3 to 2155=
Shelly slate,	7 to 2162=
Slate, blue and free from grit,	71 to 2233=
Sandstone, "bowlder," very hard,	3 to 2236=
Shelly, very gassy slate,	25 to 2261=
Slate, light and soft, not gritty,	10 to 2271=
Sandstone, not through,	52 to 2323=

Cased at 314′, but salt water came in below the casing and stood all the time within 1,000′ of the top, so that the well was virtually a "wet hole."

"We are now in a 'boulder' to the depth of 52′ with reamer stuck. All through this rock so far we got much gas."

Partially tested at 1,200′, but not afterwards. Unproductive.

CHAPTER VII.

Townships North of the Clarion River.

§ 388. The area lying north of the Clarion river is divided into ten townships.

It is principally occupied by the Conglomerate series and the Clarion group, while the summits are universally capped by the Kittanning group and at a few places by small areas of the Freeport Lower sandstone.

The *northern* and *eastern* as well as some parts of the *southern* townships contain much barren land which is always made by the outcropping Conglomerate measures.

The Clarion and *Kittanning* groups make fair,—sometimes excellent,—land, especially when the Ferriferous limestone is present in force.

§ 389. *The Ferriferous limestone* presents long lines of outcrop, often so favorably situated that large bodies of the rock are so easily accessible that a removal of from three to five feet of cover will expose a surface thirty or forty feet broad. This is especially true of those localities where this stratum caps the summits. Its *ore-bed* is reasonably persistent and generally thick enough for profitable mining, but its best and most easily worked areas have been greatly depleted— sometimes entirely exhausted. There yet remain some patches, especially those bordering on the Allegheny valley which may prove valuable, but as a whole, this bed has already furnished far more good ore than can ever be obtained from it in the future.

§ 390. *The Kittanning group* though locally furnishing some good coal is not to be relied upon as a source of future supply. This part of the county must be mainly supplied from the Clarion group, which, though rarely presenting very thick or very pure coal beds, covers an immense area and always contains one or two beds thick enough to mine.

§ 391. Most of the *good timber* has already been marketed; but in Paint, Highland and Farmington townships the lumbering interest still has a foothold which must ere long be relinquished, for what little marketable timber is still standing will soon be exhausted.

Richland Township.

§ 392. This is the most westerly township in Clarion county. It lies north from Perry township from which the Clarion river separates it, and east of Armstrong county from which it is parted by the Allegheny river.

It is well supplied with railroad communications by the Allegheny Valley, the Emlenton and Shippenville, and Foxburg, St. Petersburg and Clarion railroads.

§ 393. Its coal supply is amply sufficient to meet all local demands, a plentiful supply of limestone will always be found and a good quantity of ore is still available; the soil is variable, generally of medium quality, sometimes really good, but often miserable.

Turkey run is the largest stream running through this township.

St. Petersburg is situated on a very high ridge the terminus of the Clarion-Allegheny dividing ridge which is one and the same with the "Big Level" of McKean and Forest counties.

§ 394. The main *Clarion oil belt* with its outlying productive areas occupies the southeastern half of the township, excluding that portion south and east from the mouth of Turkey run. Some of *the first oil wells* in Clarion county were drilled along the Allegheny valley in this township.

§ 395. *The Ferriferous limestone* is finely situated for quarrying at Heater's cross-roads in the northeastern corner of the township. It lies on the crown of a long narrow ridge with but two to six feet of soft earthy covering. The bed measures from four to seven feet, and all comes out in thin flags varying from half an inch to three inches in thickness. The characteristic undulatory stratification is finely shown at all of the openings, of which there are several.

§ 395. *The Clarion Lower coal* is opened and mined at a bank owned by Mrs. Shoup between Emlenton and St. Petersburg. The bed shows about three feet of workable coal all of which is quite pyritous.

The Brookville coal has been opened at the Halfway house, but proving quite thin has been abandoned and the bank is now closed.

§ 396. *The Ferriferous limestone* should be found in nearly all the summits between Emlenton and St. Petersburg, but the scarcity of quarries upon it leads me to suspect its absence over much of that area. Some lime has been dug from an opening above the Shoup coal bank, but this quarry is not now worked, in fact there are at present no quarries in operation west of St. Petersburg.

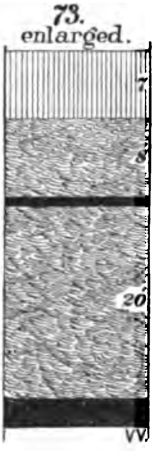
Where quarried on the Ashbaugh farm at St. Petersburg the Ferriferous limestone probably measures about seven feet. It lies thirty feet above the Clarion Lower coal, which though poor and sulphurous is largely mined from several openings near town. Most of it is used at the oil wells.

§ 397. *The Clarion Upper coal* is quite thin. It lies close under the Ferriferous limestone. An accurate section of this group was not obtained at this locality, but the following description will approximately show its arrangement: (Fig. 73.)

§ *398. St. Petersburg section.*

Ferriferous limestone, ...	7′
Shale, ...	8′
Clarion Upper coal, ...	1′
Shale, ...	20′
Clarion Lower coal, ...	3′

73.
enlarged.



The above section can be profitably compared with Fig. 64 and with the sections on Plate I. It falls naturally between the West Freedom and Edenburg sections.

§ 399. *The dividing ridge* at St. Petersburg is high enough to catch all three Kittanning coal beds, but being very thin they are not mined at present. I can call to mind no other locality in the western counties where this group is present in its integrity and yet wholly destitute of any workable coal bed.

The dividing ridge between the Allegheny and Clarion rivers averages a height of from 1475 to 1525 feet. Where crossed by the Emlenton and Shippenville railroad at McMichels Station it is 1447 feet above ocean level.

§ 400. That part of the township bordering on the Clarion river, and also the valley of Turkey run, present rough, often precipitous slopes, and sharp rugged summits which are usually capped by the Homewood sandstone or some underlying sandy layer of the Cónglomerate series.

§ 401. Taking the narrow-gauge cars of the St. Petersburg railroad at Foxburg, and mounting the river hills by a series of switchbacks, a magnificent view of the Allegheny river and valley gradually opens to sight. As the summit is approached the picture constantly enlarges until we can see far off the highlands of Butler and Armstrong counties with their myriads of derricks clearly defined against the sky as a back ground, and in front the Allegheny gorge, with here and there a glimpse of the river winding through its tortuous and deeply cut channel. Passing the divide at East Foxburg the road winds around the precipitous side hills of the Clarion river, and the tourist now views one of the most picturesque and enchanting scenes in western Pennsylvania. At his feet lies the Clarion river slowly crawling through its cañon-like gorge while beyond spread a series of sharply cut mountainous ridges wild and rugged, separated by deep precipitous gorges in which sometimes the Clarion, sometimes its tributaries, can be faintly seen, all covered by a rough uncouth second growth of timber, in which here and there small clearings may be detected, and an occasional oil derrick, the monument mayhap of some disastrous speculation, can here and there be seen, rearing its head far above the surrounding forest.

Salem Township.

§ 402. This lies north of Richland township and east from Venango county.

It is crossed by the Allegheny-Clarion dividing ridge, which running northeast passes close to Mariasville and Salem. Along its course broad open flats are universally found. These are formed by the outcropping shales of the Clarion sandstone horizon, which resting on the Homewood sandstone as an unyielding floor have been saved from further denudation.

§ 403. South of Salem and west of Mariasville some summits still retain the *Ferriferous limestone* and a small area of it is also found at the northwestern corner of the township, but over all its remaining portions this stratum is absent.

The Homewood sandstone crops out in bluff escarpments along Turkey run, Beaver creek, Snake run, Mill creek, and Ritchie run, and sometimes, but not often the underlying measures are laid bare.

§ 404. The southeast corner of the township has been punched full of holes by the driller. The west line of the productive area as at present defined enters the township near Turkey run, and passing northeast runs out through the Ashbaugh farm, near the centre of the Beaver township line.

Some good farming land occurs along the main dividing ridge. but that bordering on the larger streams is very poor.

§ 405. The coals found within its limits are—

1st. *Kittanning Lower coal*, which has not sufficient cover for profitable mining.

2d. *Clarion Upper coal*, lying close beneath the Ferriferous limestone; generally too thin.

3d. *Clarion Lower coal*, being the main reliance of the township, two and a half to three feet thick, usually quite slaty and sulphurous, and altogether an inferior bed.

4th. *Brookville coal,* much like the Clarion Lower bed; often very thin and slaty.

Numerous banks have been opened on both the Clarion Lower and the Brookville coal beds, but many of them have been allowed to cave in, and others are not worked, though still in running order.

§ 406. A high knob which rises above every other hill, can be seen from nearly every summit in the township. This is "*Beel's Mountain;* it lies at the extreme northeastern corner of the township. In and surrounding this roundtop the *Ferriferous limestone* and one or two of the *Kittanning* coal beds are found. Its elevation is sixteen hundred feet, more or less, above ocean level.

Beaver township.

§ 407. This is a large, irregularly-shaped township lying east of Richland and Salem townships, and north of Licking township. Its southeastern edge borders on the Clarion river, which separates it from Piney township, while on the northeast and east it is bounded by the Elk and Paint township lines.

Its principal streams are Beaver Canoe, and Deer creeks, which run through it in a southerly course. Both these streams run in sharp deeply cut gorges near their junction with the Clarion river, but nearer their source they flow through rather broad, open valleys.

§ 408. *The highest land* in this township is found north and northwest from Edenburg, where the hills rise to a height of one hundred and ten feet above the Ferriferous limestone.

South from Edenburg the country is planed off to a much lower level. This will at once be seen by reference to the geological map, but the latter does not, however, show the exact relative heights of these hilltops, for it fails to show the Ferriferous limestone is some of the hills that are high enough to contain it, but in which it is absent.

§ 409. *The productive oil territory,* as at present defined, is limited to the northwestern half of this township. Detached areas, isolated by barren ground from the best territory, will undoubtedly be developed by future operations, just as the productive spots at Wentling's Corners, Blair's and Black's Corners, and around Edenburg, were discovered and operated upon long after the main "belt" had been thoroughly defined.

§ 410. Very little good *farming land* exists within this township, and much, as for instance near Edenburg, has been temporarily ruined by the operations of drilling for and producing oil. The soil is mostly poor, cold, often clayey, and as frequently stony: this is especially true of the southern half of the township. Beaver, Tippecanoe, Eagle, and other furnaces long ago exhausted all the good timber, and the land is now covered with a scraggy second growth of chestnut, oak, birch, hemlock, etc.

§ 411. A fair *supply of coal* can always be obtained from the Clarion group, which often contains two workable beds of fair quality. The Kittanning group is not well developed, and at any rate is available only in the high lands near Edenburg. A sufficient quantity of lime can always be obtained from the hills near Beaver city and Edenburg.

§ 412. Large tracts of comparatively untouched *Iron Ore* can be found in all the hills facing the Clarion river gorge. The ore referred to is not that overlying the Ferriferous limestone; it is a series of carbonate layers, the best of which are found in the shales subjacent to the Homewood sandstone. These were largely worked for use in all the charcoal furnaces in this part of the county.

The Ore is rich in iron but sometimes contains a very detrimental percentage of phosphorus and sulphur. It lies in bluish shale, sometimes in plates, or again in scattered nodules or balls, and has no definite thickness. Another ore horizon is sometimes found between the Brookville and Clarion coal beds, but this is completely overshadowed by those already described.

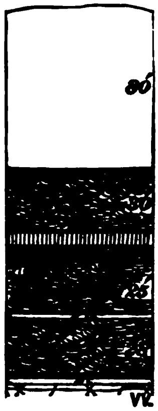
§ 413. *The Millerstown anticlinal axis* enters the township near the mouth of Canoe creek and running northeast passes out into Elk township, a short distance northeast of the McElhatten and McDowell coal banks.

A section of one hundred and eighty-nine feet of measures compiled from exposures near Edenburg is shown by Fig. 74, reading thus:

§ *414. Edenburg Section:*

Summit, shale with sandstone layers,	80′
Kittanning Lower coal,	1′ 2″
Fireclay,	30′
Shale,	
Ore,	0′ 6″
Ferriferous limestone,	7′
Sandstone,	1′
Slaty shale,	6′
Clarion Upper coal,	1′
Slaty shale,	25′
Clarion Lower coal,	1′ 6″
Fireclay,	3′
Shale,	28′
Brookville coal,	2′
Fireclay,	3′
Homewood sandstone,	top.

74.



This section affords another link in the chain of evidence the Scrubgrass coal to be a split from the Clarion coal bed, and has been included as one of the sections for Plate I.

§ 415. *The Kittanning Middle coal* was not detected at Edenburg. It is evidently quite thin, as is also the Kittanning Lower bed which measures but fourteen inches, being therefore too thin to mine. The hill above is just capped by the Freeport Lower sandstone, which lying somewhat below its proper horizon apparently cuts out the Kittanning Upper coal.

§ 416. *The Ferriferous limestone* has been quarried extensively from openings near the railroad at Edenburg. It shows seven feet of stone with six feet of suprajacent plate ore. Numerous crinoid stems and a few *Terebratulæ* can be seen in almost every fragment of the rock. The quarried stone sells for seventy cents per ton at the quarry and for one dollar and twenty-five cents at the railroad station at Clarion.

§ 417. *The Clarion Upper coal* is only one foot thick. It lies seven feet beneath the limestone.

The Clarion Lower coal has been opened and mined at a bank on the J. I. Best farm near the limestone quarry where the bed measures from one foot five inches to one foot and seven inches. It shows a bad pyrite layer one inch thick on top the seam, and an occasional hard but thin slate parting some six inches below the sulphur band. This coal lies thirty-three feet beneath the Ferriferous limestone.

The Brookville coal is found twenty-eight feet beneath the Clarion Lower coal. It is only two feet thick, very impure, and is not mined.

§ 418. One mile and a half southeast from Edenburg a group of about six coal banks have been opened on what are apparently the *Clarion Upper* and *Lower* coal beds. These openings are situated on the Daniel Smith and Daniel Barnett farms.

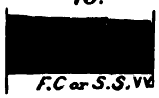
The Ferriferous limestone should be found in the hill above the banks but though diligent search has frequently been made it has never been found.

The Clarion Upper (?) coal is the thickest; it is commonly said to average two feet and a half but in places it measures fully three feet, and again may often yield but two feet and three inches. One measurement of this coal is shown by Fig. 75, thus:

§ *419. Smith and Barnett coal banks.*

Slate roof.	
Coal, ...	2′ 6″
Fireclay, sometimes sandstone floor.	

75.



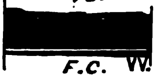
The coal is hard and black but though somewhat pyritous, makes an excellent steam coal.

The Clarion Lower (?) coal lies ten feet beneath the upper (?) bed. It contains a binder of bone two inches thick, but is not so sulphurous as the upper bed. A measurement of this coal shows, Fig. 76.

§ *420. Barnett coal bank:*

Slate roof.		
Coal, ...	1′ 5″	1′ 9″
Bone, ...	2″	
Coal, ...	1″ to 2″	
Fireclay floor.		

76.



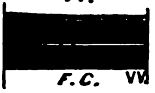
§ 421. Mr. John Cavanagh has charge of one of the Smith farm banks which with the help of his two sons he has made a model piece of mining engineering. The entries are roomy and substantially built, ample drainage is provided for sudden floods, while an air shaft, furnace and the necessary trap-doors, &c., insure good ventilation. He employs the long-wall system and loses very little coal. All these banks are located near the Millerstown synclinal trough but being a short distance southeast of the axis show a dip northwest by west.

§ 422. *The Clarion Upper coal* is opened and mined three miles southeast from Edenburg, on farms owned by Messrs. Joseph and Amos Delo. The coal drains *east*, while west west of this point it dips *westwardly*, showing that we are here situated nearly on the Millerstown anticlinal crest. One measurement of this coal is shown by Fig. 77, reading:

§ 423. *Delo coal banks.*

State roof.		
Coal, ...	1′ 1″	2′ 5″
Slate, ...	2″	
Coal, ...	1′ 2″	
Fireclay floor.		

77.



No trace of the *Ferriferous limestone* can be found in this part of the township; it is probably absent. In fact, at Delo's there is hardly sufficient hill to catch it.

The Clarion Lower coal was seen in blossom beneath the upper bed. It has not been opened.

The Brookville coal was opened and mined some years ago at a bank some distance southeast from the Delo banks, but it has been abandoned, and the opening is now closed. It lies about fifty feet beneath the Clarion Upper coal.

§ 424. Beaver furnace worked an ore bed lying in the Mercer group horizon. Old diggings on this bed are still visible at many places in the southeastern part of the township. Their geological horizon is always easily determined by the Homewood sandstone, which juts out in rugged escarpments above the ore-bearing shales.

§ 425. *The Brookville coal* is mined for use at the oil wells at a number of banks south of Monroeville, or Dogtown as it is sometimes called. The bed is quite thin and could not be mined at a profit, were it not for the large demand created by numerous oil wells. The Clarion sandstone, which immediately overlies this coal, is here a hard massive rock, strewing the ground with large irregular fragments, but is nevertheless easily distinguished from the Homewood sandstone,—also a hard massive rock,—lying a few feet beneath the coal.

§ 426. *The Clarion Upper* or *Lower* coal (possibly both) is mined at three banks on the road running west from Blair's Corners. These openings show from two feet two inches to two feet and ten inches of fair coal, with sufficient cover.

The following oil well records were obtained by Mr. John H. Carll, who was detailed in 1877 to this special work. Sand pumpings were taken at each and every important change in the character of the formations passed through, and steel-wire measurements of the depth made at suitable intervals. These records will be found printed in report I.I.I., where they are fully described and discussed, but as they are the only really trustworthy records we have of the Clarion county underground rocks, it seems proper that they should have a place in this report.

A comparison made between any two of these records shows at once how variable these underground formations are; for an interval of sandstone in one well is often occupied by shale in another, and *vice versa*. But notwithstanding these great irregularities, there is a *general uniformity*, which becomes at once apparent on comparison of three or four accurately kept records. A certain thickness of loose whitish and yellowish sandrock is passed through in all these wells, which is succeeded by fine-grained greyish sandstones, closely followed by an interval of soft measures; to these succeed the oil sands in a group, occupying about three hundred and twenty-five feet.

§ 427. *Brundred Well, No. 4.*

JUNE, 1877.

Owned by Benjamin Brundred, and located on Capt. Kribb's farm, at Beaver City, one mile S. 55° W. from Edenburg, one mile S. 85° W. from Columbia Oil Co.'s well, No. 19, and a quarter of a mile S. 20° W. from Haney well, No. 4. Authority, John H. Carll.

Well mouth above ocean in feet,							1480
Conductor,	[soil and rotten rock,]			11 to	11	=	1469
Shale,	dove-color, muddy,	53		79 to	90	=	1390
Shale,	bluish grey, sandy,	26					
Sandstone,	light grey, gritty, micaceous,	40		66 to	156	=	1324
Trace of coal,		—					
Sandstone,	dark grey, fine, muddy, micaceous,	26					
Slate,	black, lower half sandy,	43		60 to	216	=	1264
Slate,	with grey sand shells,	17					
Sandstone,	grey, fine, micaceous;	13		79 to	295	=	1185
Trace of coal,		—					
Sandstone,	light grey, coarser, and more gritty,	30					
Sandstone,	white, fine, mixed with bituminous slate,	15					
Sandstone,	grey, medium,	21					
Slate,	dark,			4 to	299	=	1181
Sandstone,	dark grey, fine, muddy,	5	**"Mountain Sand,"**	124 to	423	=	1057
Sandstone,	dark grey, cleaner, coarser,	15					
Sandstone,	white, soft, micaceous, "buttermilk rock,"	13					
Sandstone,	white, hard, fine, gritty,	13					
Sandstone,	white, coarse, gritty,	48					
Sandstone,	grey and dark mixed, micaceous,	5					
Sandstone,	white, olive, and buff, fine,	2					
Sandstone,	grey, fine, gritty,	23					
Slate,	with grey sand shells,			17 to	440	=	1040
Shells,	very fine and hard, thin layers of slate,			25 to	465	=	1015
Slate,	black, somewhat sandy,			16 to	481	=	999
Red,	chocolate-colored slate,			4 to	485	=	995
Slate,	dark,			13 to	498	=	982
Sandstone,	grey, fine, muddy, micaceous,	33	**"40', or Salt-Water Rock,"**	130 to	628	=	852
Sandstone,	slightly mixed with slate, fossils, (?)	59					
Sandstone,	whiter and less slaty,	38					
Slate,	with hard, grey, micaceous shells,			7 to	635	=	845

Shells,	soft, with slate, polishing tools, good drilling,		35 to 670 =	810
Slate,	dark, some shells,	46	245 to 915 =	565
Slate,	dark, shells more frequent,	56		
Slate,	purplish, hard shell at 790′	27		
Slate,	dark, sandy, with hard shells,	7		
Slate,	dark, sandy shells less frequent,	46		
Slate,	dark, almost free from shells,	65		
First sandstone shells,	grey, very micaceous, with layers of slate,		23 to 938 =	542
Slate,	olive, with very fine, micaceous shells,		51 to 989 =	491
Shells,	grey, very hard, fossils, (?)		2 to 991 =	489
Slate,	dark,		25 to 1016 =	464
Red Shale,			1 to 1017 =	463
Slate,	with light grey, hard shells,		74 to 1091 =	389
Sandstone,	grey, hard, micaceous, a few yellow pebbles,	2	16 to 1107 =	373
Sandstone,	grey, very fine, and hard,	14		
Slate,	dark,		2 to 1100 =	371
Shell,	light grey, fine, gritty, very hard,		2 to 1111 =	369
"Big Red,"	sandy, micaceous, shelly,		41 to 1152 =	328
Slate,	dark blue,		10 to 1162 =	318
Red Shale,			6 to 1168 =	312
Slate,	purplish, with hard, nearly white shells,		19 to 1187 =	293
Shell,	of sand, with white, yellow, and red pebbles,		1 to 1188 =	293
Slate,	dark, with fine, hard shells,		5 to 1193 =	287
Sandstone,	dark grey and hard,	1	26 to 1219 =	261
Sandstone, cream-colored, small pebbles, fossils, (?)	medium grain, very uniform all through,	25		
Slate,	dark,		1 to 1220 =	260

Drilled dry. Cased at 427′. No salt water below casing. No gas above 3d sand, and but little in that. No solid 1st sand form in this well, only shell where the sand should have been.

Production, 35 barrels per day for some time, when it suddenly dropped to 10 barrels.

This well was 400 feet deep when taken in charge. Down to that point the record here given was obtained from Haney well, No. 4. As the two wells are only 80 rods apart, and nearly the same level, the record probably does not vary materially from what it would have been if taken from this well.

§ 428. *Columbia Oil Company Well, No. 19.*

JULY 7, 1877.

Owned by Columbia Oil Co., and situated on their J. H. Kiser farm, 3000 feet S. 23° E. from Edenburg, one mile N. 85° E. from Brundred Well, No. 4, and half a mile west from McGrew Bros.' Well, No. 4.

Well mouth above ocean in feet,						1443
Conductor,	[soil and rotten rock,]			12 to	12 =	1431
Slate,	dove-colored and very muddy,	18		126 to	138 =	1305
Slate,	dark, dove-colored, very muddy,	47				
Slate,	black, with iron pyrites,	45				
Slate,	with grey sand shells,	16				
COAL,				1 to	139 =	1304
Slate,	shelly,			7 to	146 =	1297
Sandstone,	grey, fine, gritty,			44 to	190 =	1253
Slate,	dark, with occasional thin shells,			33 to	223 =	1220
Sandstone,	very dark, fine, micaceous,	54	**Mountain Sand,**	146 to	369 =	1074
Sandstone,	white, medium fine, fossils?	33				
Sandstone,	white, fine,	5				
Sandstone,	grey, fine,	20				
Sandstone,	dark-grey, fine, micaceous, soft,	19				
Sandstone,	dark-grey, very fine, tough, rubber "rock,"	15				
Slate,	with dark shells, hard drilling,			11 to	380 =	1063
Sandstone,	dark-grey, fine, hard, flaky, muddy,			15 to	395 =	1048
Slate,	dark-blue,			31 to	426 =	1017
Sandstone,	dark-grey, very fine, tough,	30	**"40 Foot Rock,"**	144 to	570 =	873
Sandstone,	dark-grey, coarser, gritty,	29				
Sandstone,	or sandy, micaceous slate,	12				
Sandstone,	like No. 1,	30				
Sandstone,	grey, very fine, fossils?	21				
Sandstone,	grey, medium, slaty, micaceous fossils?	22				
Slate,	dark, tough, granulating like sand,			48 to	618 =	825
Slate,	with an occasional very fine sand shell,			37 to	655 =	788
Slate,	with frequent hard blue micaceous shells,			40 to	695 =	748
Slate,	purplish,			7 to	702 =	741
Slate,	dark, fawn color, with grey shells,			12 to	714 =	729
Sandstone,	dark-grey, fine, micaceous, soft,			7 to	721 =	722
Slate,	with very fine shells, green and grey,			118 to	839 =	604

Sandstone,	white, with white and yellow pebbles,	2	**1st Sand,**	16 to 855 =	588
Sandstone,	pure white, medium, fossils?	4			
Sandstone,	pure white, fine,	10			
Slate,	soft "soapstone,"			24 to 879 =	564
Sand shells,	grey,			2 to 881 =	562
Red Rock,				1 to 882 =	561
Slate,	with grey sand shells,			5 to 887 =	556
Sandstone,	white, very fine, hard,	1		21 to 908 =	535
Sandstone,	white, medium, fossils?	5			
Sandstone,	grey, very fine, micaceous,	15			
Slate,	with grey shells,	4		304 to 938 =	505
Slate,	with green shells,	8			
Slate,	with grey shells frequent,	18			
Red,	fine grey sand and red clay,			3 to 941 =	501
Slate,	dark, with fine, hard, grey shells,			40 to 981 =	461
Sand shells,	grey, grey and olive, fossils?			4 to 985 =	458
Slate,	dark, with grey shells,			32 to 1017 =	426
"Big Red,"	red and green sandy shale,	9		39 to 1056 =	387
"Big Red,"	brownish-red, sandy, micaceous slate,	30			
Slate,				3 to 1059 =	384
Sandstone,	grey, gritty, micaceous, flaky,			9 to 1068 =	375
Slate,	sandy,			13 to 1081 =	362
Red Rock,				2 to 1083 =	360
Slate,	purplish, sandy,			21 to 1104 =	339
Shells,	grey, hard, with yellow pebbles,			2 to 1106 =	337
Slate,	with fine, grey, hard shells,			11 to 1117 =	326
Sandstone,	with white and yellow pebbles,	5	**3d Sand,**	26 to 1143 =	300
Sandstone,	grey, very fine,	1			
Sandstone,	cream color, fine,	4			
Sandstone,	fine-pebble sand, fossils?	4			
Sandstone,	cream color, fine, fossils?	12			

Not through the 3d sand.

Drilled dry. Cased at 567′. No water found below casing. No gas above 3d sand, and but little in that.
Production from 5 to 6 barrels per day.
This well was torpedoed before the tubing was inserted, and made one flow over the top of the derrick.

§ 429. *McGrew Bros.' Well, No. 4.*

JUNE 13, 1877.

Owned by McGrew Bros., and situated on the McIlhatten farm, one mile S. 50° E. from Edenburg, and half a mile east of Columbia Oil Co.'s Well, No. 19.

Well mouth above ocean in feet,					1316
Conductor,	[soil and rotten rock,]		8 to	8 =	1308
Sandstone,	reddish, gritty, medium grain,	18	50 to	58 =	1258
Sandstone,	grey, gritty, fine, with streak of coal slate,	32			
Sandstone,	slate colored, very fine, with slate and pyrites,	22	36 to	94 =	1222
Sandstone,	slate colored, very fine, hard, micaceous,	14			
Sandstone,	white, gritty, medium, with hard streaks, and somewhat grey and soft at bottom,		98 to	192 =	1124
Slate,	fawn-colored and dark-blue, with light-grey, fine, hard sand shells frequent and thick,	66	92 to	284 =	1032
Slate,	dark-blue, with grey sand shells,	7			
Slate,	fawn color and blue, free from shells,	19			
Sandstone,	grey, very fine, thin bands of slate, hard drilling,		61 to	345 =	971
Slate,	and olive shells, in about equal proportions,		19 to	364 =	952
Sandstone,	grey, fine, gritty, micaceous,	48	64 to	428 =	888
Sandstone,	dark-grey, a few pebbles at top, with hard, close, slaty shells towards bottom,	16			
Slate,	blue, soft, muddy,		52 to	480 =	836
Slate,	blue, sandy, hard, thin shells, at 505', 530', and 565',		102 to	582 =	734
Shells,	light-grey, fine, hard, little *gas*,		2 to	584 =	732
Slate,	black and sandy, hard,		1 to	585 =	731
Shells,	hard, with blue and fawn-colored slate,		9 to	594 =	722
Slate,	dark, micaceous,		117 to	711 =	605
Sandstone,	white, coarse, yellow and pink pebbles, on top, (7',) fine and milk white at bottom, **"First Sand,"**		21 to	732 =	584
Slate,	common,		15 to	747 =	569
Red,	sandy, micaceous, but slightly colored,		6 to	753 =	563
Slate,	dark, with grey sand-shells,		12 to	765 =	551
Shells,	grey, fine, micaceous,		4 to	769 =	547

Slate,	common,			12 to 781	=	535
Shells,	olive-grey, fine, micaceous, with slate,			13 to 794	=	522
Red,	very fine, micaceous, flaky sand,			4 to 798	=	518
Slate,	dark, with fine grey sand-shells,			12 to 810	=	506
Red,	olive and red sandy shales,			2 to 812	=	504
Slate,	black, with fine, grey, micaceous shells,			37 to 849	=	467
Red,	sandy shale, hard,			2 to 851	=	465
Slate,	with hard shells,			3 to 854	=	462
Sandstone,	light grey, fine, flaky, muddy, micaceous,			4 to 858	=	458
Slate,	somewhat shelly,			12 to 870	=	546
Sandstone,	light grey, fine, flaky, muddy, micaceous,			31 to 901	=	415
"Big Red,"	red and green sandy shale,	33		42 to 943	=	378
"Big Red,"	brownish-red sandy slate, very micaceous,	9				
Slate,	dark, with grey micaceous shells, some pebbles,			6 to 949	=	367
Slate,	common,			35 to 984	=	332
Slate,	with thin sand-shells, containing pebbles,			9 to 993	=	323
Sandstone,	greyish-white, micaceous,	10	**Third Sand,**	30 to 1023	=	293
Sandstone,	pebble sand, yellow and white,	4				
Sandstone,	firm, dark grey, fossils, (?)	9				
Sandstone,	olive-grey, with slate,	2				
Sandstone,	cream-color, very fine, clean sand,	2				
Sandstone,	orange-grey, fine, flaky, fossils, (?)	3				
Slate,	common, with and occasional pebble,			17 to 1040	=	276
Fourth sand,	grey, fine, flaky, muddy, some pebbles in top, (1') fossils. (?) Not through it,			10 to 1050	=	266

Drilled dry. Cased at 430'. A small quantity of salt water in the 1st sand, and a slight show of gas. But little gas in 3rd sand. Average production, 2 barrels per day, apparently from the 3rd sand.

Ashland township.

§ 430. This lies due north from Salem and Beaver townships, west of Elk township and south and east of Venango county.

It is drained by East Sandy, Little Sandy creek, Kolp's and Date run which lying northwest of the dividing ridge flow into the Allegheny river, and by the headwaters of Beaver and Canoe creeks flowing in an opposite direction into the Clarion.

The Allegheny-Clarion divide passes through the township in a winding course from southwest to northeast. Its summits are 1500 to 1575 feet above ocean level.

§ 431. *Some oil* has been found north of Mongtown in the extreme southeastern corner of the township. Test wells sunk in other parts of this township have thus far proven unproductive.

§ 432. *The soil* is of fair quality, that near the summits being especially good; the supply of limestone is inexhaustible and the coal supply amply sufficient to supply all local needs. *The Ferriferous limestone* is found in all the higher hills. At the quarry owned by Mr. Harmer Phipps in the eastern part of the township from six to six and a half feet of stone is found lying on a thin flagstone floor. It has only from one to five feet of cover, and being so favorably situated has been extensively worked. It is used by the farmers for miles around, who prefer to pay for the stone and team it home rather than make openings on their own lands. Its suprajacent ore is thin,—in fact often wanting,—and has been worked but little.

§ 433. *The Kittanning Lower coal* is caught in some of the highest hilltops but has so little covering that it is too soft to mine, excepting at one or two localities, and at these it is thin and quite impure.

The Clarion Upper and *Lower coals* and also the Brookville bed have been opened and worked at numerous banks in different parts of the township. They rarely measure much more than two feet and as a rule furnish rather poor coal, though good coal is obtained at a few openings. They are worked only as a country banks to supply the local demand for household consumption.

§ 434. *The Homewood sandstone* hard and massive and some of its subjacent shales is exposed on East Sandy and Little Sandy creeks. It always marks a steep stony escarpment at its place of outcrop, which ruins land lying at a lower level.

Elk Township.

§ 435. This is a rather large township lying east of Ashland and north and east from Beaver township. Its north line borders on Venango county and Washington township.

The Allegheny-Clarion divide runs nearly east through its northern portion for some distance nearly coinciding with the Washington township boundary line. The area south of this ridge is drained by Little Deer creek, Judy's run, Kanney's run and other small streams, all of which are tributary to Deer creek; while all that north of the divide is drained by East Sandy creek.

§ 436. As a rule *the soil* is poor, sometimes very poor, but here and there good farms are occasionally seen. The poverty of much of the soil made by a disintegration of the Coal measure shales and sandstones is undoubtedly due to the absence of the Ferriferous limestone over large tracts in which it should be found.

§ 437. *The coal supply* will always be sufficient to meet the local demand, but to do this thin impure beds must be worked.

The Clarion group always furnishes at least one workable bed, where the land is high enough to catch it, but this is not always either thick or of very good quality.

The Brookville coal has been opened at several banks. The bed is thin and consequently is not much worked. It can usually be found by prospecting for it a few feet above the Homewood sandstone which being quite hard, though not often massive, always makes a prominent terrace at its place of outcrop.

§ 438. *The Ferriferous limestone* is rarely seen north of Shippenville. It has been opened and quarried in a hill near the headwaters of Deer creek and Kanney's run near the Ashland township line.

§ 439. As at present defined the *oil producing area* is limited to that part of the township lying west of Shippenville. Though forty or fifty wells have been drilled northeast of the Shippenville pike in search of the northeastern extension of the Clarion county oil belt, these have thus far only yielded negative results.

§ 440. *Several ore banks* have been worked in this township for use at Shippenville, Black's, Beaver and other furnaces. The old openings are all closed and an accurate description cannot be made by simply visiting the localities.

§ 441. The following extracts from the report of the First Survey page 570 show their general character.

"At Deal's bank, two miles south of Shippenville the Ferriferous limestone ore has been extensively wrought upon a flat-topped hill. The ore was from six to four feet thick (!) being exceedingly variable even in short distances.

"Over it lie about six feet of argillaceous slaty sandstone and shale bedded in a very irregular manner, and divided in several places by joints. Above this lies a brown shale.

"The ore is accompenied by chert, which occurs in pieces from ten to four inches square, and appears to be most abundant in the upper part of the ore bed. The limestone is separated from the base of the ore bed by a greenish slaty sandstone several feet in thickness."

"The Clarion (Upper) coal has been opened in this neighborhood. "It cannot be much more than fifteen feet below the limestone. It is from two and a half to three feet thick."

"The Brookville (?) (Clarion Lower ?) coal is upwards of twenty feet lower down, and is an inconsiderable bed."

§ 442. On page 569 we also find: "Issuing from the base of the conglomerate (Homewood sandstone), bog-ore is found east of Shippenville."

The following analysis of ore from the Deal bank is found on page 740:

Peroxide of iron,	83.00
Peroxide of manganese,	2.00
Alumina,	trace.
Water,	12.50
Insoluble matter,	2.81
Metallic iron,	58.10

"Purplish-brown, hematitic, cellular."

§ 443. These ore deposits were all practically exhausted by the old workings, but a large amount of untouched carbonate ore still remains in the shales subjacent to the Homewood sandstone. Whether these deposits are thick enough and pure enough for profitable mining is as yet unknown.

The Millerstown anticlinal axis crosses the southeastern corner of the township, passing close to Shippenville furnace.

The following oil well records have been transferred bodily from Report I.I. and reproduced to show the general features of the underground stratigraphy of this part of Clarion county.

§ *444. Hope Well.*

June 29, 1876.

Camp Ridge farm, Elk township, Clarion county, owned by Hess, Bradly & Co. Authority, M. E. Hess.

Well mouth above ocean, in feet,		1324
Conductor, clay and sandy loan,	10 to 10	= 1314
Sandstone,	54 to 64	= 1260
Slate, gray,	7 to 71	= 1253
Sandstone, brown,	8 to 79	= 1245
Sandstone, white,	51 to 130	= 1194
Slate, dark,	42 to 172	= 1152
Sandstone, white,	27 to 199	= 1125
Slate, black,	18 to 217	= 1107
Sandstone, greenish,	8 to 225	= 1099
Slate, gray,	5 to 230	= 1094
Sandstone, dark,	94 to 324	= 1000
Slate, very dark,	70 to 394	= 930
Shale, gray,	25 to 419	= 905
Slate, gray,	90 to 509	= 815

Shale, dark,	30	to	539	=	785
Slate, whitish cast,	110	to	649	=	675
Shale, dark,	50	to	699	=	625
1st sandstone, dark,	45	to	744	=	580
Sandstone, black,	10	to	754	=	570
Red rock,	10	to	764	=	560
Slate, black,	13	to	777	=	547
Sandstone, light,	22	to	799	=	525
Slate, reddish,	16	to	815	=	509
Sandstone, gray,	31	to	846	=	478
Slate, dark,	6	to	852	=	472
Red rock, dark red,	45	to	897	=	427
Slate, light,	12	to	909	=	415
Sandstone, greenish,	12	to	921	=	403
Slate, dark,	11	to	932	=	392
Sandstone, white,	3	to	935	=	389
Slate, light,	4	to	939	=	385
3d sandstone, dark,	3	to	942	=	382
Pebble and sand, some oil,	13	to	955	=	369
Sandstone,	22	to	977	=	347

Drilled dry. Cased at 333′. Best production, 5 barrels per day. Half enough gas to fire one boiler. Green oil.

§ 445. *Shippenville Furnace Well.*

1865. (?)

Jacob Black farm, Elk township, Clarion county. Authority, Jacob Black, Jr.

Well mouth above ocean in feet.

Conductor,	26	to	26	=	
Sandstone, (Sandstone,) white,	16	to	42	=	
Mud rock, yellow,	3	to	45	=	
Sandstone, blue, close,	11	to	56	=	
Slate,	3	to	59	=	
Sandstone, blue, coarse,	65	to	124	=	
Slate, water crevice,	4	to	128	=	
Sandstone, blue,	24	to	152	=	
Slate, shelly,	320	to	472	=	
Sandstone,	22	to	494	=	
Slate, hard,	30	to	524	=	
Sandstone, shelly,	3	to	527	=	
Slate,	3	to	529	=	
Sandstone,	5	to	534	=	
Red rock,	2	to	536	=	
Slate, hard,	10	to	546	=	
Sandstone, blue, 5′ top fine, 10′ bottom coarse,	15	to	561	=	
Slate, shelly, very hard,	139	to	700	=	
Sandstone, gray,	15	to	715	=	

Red rock, red sand,	**15 to**	**730 =**
Sandstone, gray,	**5 to**	**735 =**
Red rock,	**20 to**	**755 =**
Slate, shelly,	**10 to**	**765 =**
Red rock,	**45 to**	**810 =**
Slate, shelly, hard,	**62 to**	**872 =**
Sandstone,	**20 to**	**892 =**
Slate,	**15 to**	**907 =**
Sandstone,	**42 to**	**949 =**
Slate,	**16 to**	**965 =**
Sandstone, white,	**3 to**	**968 =**
Slate, open,	**16 to**	**984 =**
Sandstone, white,	**3 to**	**987 =**
Slate, soft,	**10 to**	**997 =**
Red rock,	**5 to**	**1002 =**

Wet hole. Cased at ——′. Unproductive.

Paint Township.

§ 446. This lies next east from Beaver and Elk townships, and north of the Clarion river, which separates it from Piney, Monroe, and Clarion townships.

It is drained by Paint creek flowing west into Deer creek, and Toby creek which flows southwest into the Clarion river. Between these two streams, and between Deer creek and the Clarion river, is a high dividing ridge, which averages about 1450 to 1500 feet above ocean level; where crossed by the narrow-gauge railroad it measures 1435 feet.

The Millerstown anticlinal axis runs across the northwestern corner of the township, nearly conforming to the average course of Paint creek.

This township is remarkable only for its extreme homliness. The land is rough, stony, unimproved, and unfit for farming; it is mostly covered by a scraggy, uncouth, second growth of timber hardly deserving a better name than "undergrowth."

§ 447. More than two thirds of the township is made by the outcropping conglomerate measures, which accounts for much of the poor soil. The coal measure shales are nearly destitute of calcareous matter,—the Ferriferous limestone being absent,—and make very poor clayey soil.

§ 448. *Iron ore.*—On the Shippenville pike, a short distance east from Deer creek, a bed of carbonate kidney *Ore* is exposed along the roadside at a distance of about thirty-five feet beneath the Homewood sandstone. It belongs, therefore, in the same horizon with the Mercer group, and with the Bear creek ores of Butler county. The bed measures from six inches to two feet, and is underlaid by two feet of shale, beneath which a small coal seam was seen. Banks have been opened on this coal in some parts of the township, but the bed is always quite thin and slaty, though not troubled much by pyrites. It is, of course, impossible to identify this coal with either the Mercer Upper or Lower bed; but that it lies in the Mercer horizon is demonstrated by the character of its associate measures.

The above described ore was mined for use in Beaver, Black, and Shippenville furnaces, but as it is hard to smelt, though of good quality, these stacks probably used it only when the limestone-ore could not be cheaply obtained.

§ 449. *The Brookville* and *Clarion coal beds* have been opened at many places in this township, but nearly all these openings have fallen shut. They are both thin, slaty, and often very sulphurous. The hills do not catch enough of the coal measures to make good farming land, and though they are often high enough to contain the Ferriferous limestone, it cannot be found. Nearly all the arable soil of the township needs liberal applications of lime, and can only be made productive by its use.

§ 450. *Oil.*—A few test wells have been drilled, but oil has never been found in paying quantities within the township limits

Highland Township.

§ 451. This lies east of Paint, south and east of Knox and south and west of Farmington township. The Clarion river forms its southeastern boundary.

Toby creek runs along its northern border in a course nearly parallel to the Clarion river, from which it is separated by a bold dividing ridge.

The *western* and *southern* parts of the township do not materially differ from the lands of Paint township, but at and around Helen furnace a very different country is seen. The hills here catch the *Ferriferous limestone* and some of the overlying coal measures, the outcrops of which form very fair farming land.

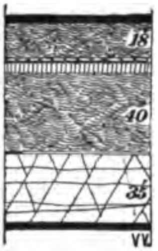
§ 452. *The Brady's Bend synclinal* traverses the township. Its trough probably lies between Helen furnace and the Clarion river, and to its position is due the presence of the Ferriferous limestone and its associate rocks.

§ 453. A section compiled from exposures near the furnace is shown by Fig. 78. The description fails to show the Clarion coal not because that bed is absent, but because it was not actually seen. Its horizon is indicated. By some oversight I have neglected to show the amount of covering over the Kittanning Lower coal. It amounts variably to from ten to thirty-five feet.

§ *454. Helen Furnace section:*

Kittanning Lower coal, ...	3′ 6″
Fireclay, ... Shale, ...	18′
Ore, ...	6″ to 2′
Ferriferous limestone, ...	6′
Shale, ...	40′
Clarion (Lower) coal, not seen.	
Clarion sandstone, ...	35′
Brookville coal, ...	3′
Fireclay and shale,—not measured.	
Homewood sandstone.	

78.



The Ferriferous limestone has been opened in only one hill, but though the summits for two miles around the furnace are apparently high enough to contain it, it or the overlying ore bed have been discovered in these outlying hills. The outcrop of this stratum has therefore been marked on the geological map by a broken line.

§ 455. *The ore* varies from six inches to two feet. Large quantities, probably the best of it, have been taken out and worked up by Helen furnace. It lies immediately on top the limestone, of which from five to seven feet are found, and about twelve to eighteen feet beneath the Kittanning Lower coal. The latter ranges from three feet to three feet and six inches with an occasional thickness of four feet. One measurement is shown by Fig. 79, as follows:

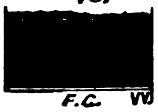
§ 456. *Coal bank at Helen furnace.*

Slaty shale roof.

Coal, ...	3′ 5″
Slate, ...	1″

Fireclay floor.

79.



The coal is bright and hard with no persistent slate parting but its quality is somewhat impaired by the presence of thin pyritous laminae. A seam of slate immediately beneath the coal, makes an excellent "bearing-in" layer.

§ 457. *The Clarion sandstone*, thirty-five feet thick, outcrops along the roadside forty feet more or less below the Ferriferous limestone. This might at first sight be mistaken for the Homewood sandstone, but to one familiar with the varying differences between that rock and the Clarion sandstone, its identification with the latter is at once apparent. Its friable nature, pinkish or reddish color, the character of its outcrop and of the soil it forms, together with the existence of a hard and massive rock,—the Homewood,—beneath it, and its associate suprajacent strata prove beyond doubt its identity with the Clarion sandstone.

§ 458. *The Brookville coal bed* has been opened and worked at several places. It ranges from two and a half to three feet, but always furnishes very inferior coal.

Knox Township.

§ 459. This is a very small irregularly shaped township lying north of Paint and Highland.

It is drained by Paint and Toby creeks and their branches. These run in sharp ravines which are generally cut through the Homewood sandstone into the underlying measures.

§ 460. *The surface* is mostly occupied by the outcropping

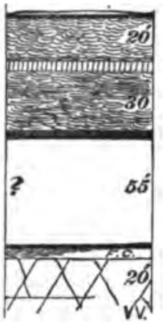
Clarion group, but a large area is also underlaid by the Homewood sandstone. The Ferriferous limestone is only found in the high lands east of Lucinda furnace. Its presence here is partially attributable to the Millerstown anticlinal which passes close to Lucinda P. O. in its northeasterly course across the township.

A section of one hundred and forty-five feet compiled from exposures near Lucinda furnace is shown by Fig. 80:

§ *461. Lucinda furnace section.*

Shale in summits,	thin.
Kittanning Lower coal,	2′
Fireclay, Shale, . } about	20′
Ore,	6″ to 2′
Ferriferous limestone,	4′ to 5′
Slaty shale,	30′
Clarion [Lower] coal,	4′
Concealed,	55′
Brookville coal,	1′ to 1′ 6″
Fireclay and shale,	5′
Homewood sandstone (over)	20′

80.

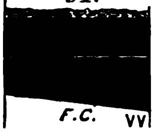


§ 462. *The Kittanning Lower coal* has very little cover. It is not mined. The Clarion [Lower] coal ranges from three feet and nine inches to four feet eight. It furnishes a very fair article but its quality is much impaired by numerous thin layers of pyrite and by a persistent bony parting near the middle of the bed. The coal ordinarily shows the arrangement exhibited by Fig. 81:

§ *463. Lucinda coal banks.*

Shale roof.	
Coal,	1′ 11″ to 2′ 0″
Bony sulphur band,	1″
Coal,	1′ 10″ to 2′ 7″
Fireclay floor.	

81.



Fifty-five feet beneath this comes the *Brookville bed* which yields much better coal, but being only from twelve to eighteen inches thick cannot profitably be mined. The

Homewood sandstone, a hard, massive, cliff-making rock occurs a few feet beneath this latter coal.

The Clarion sandstone can hardly be detected in this neighborhood.

§ 464. *The Ferriferous limestone ore* has been extensively mined for use in the Lucinda stack. As it is difficult to give an accurate description of either the ore or its associate rocks from a mere inspection of the now abandoned and almost obliterated openings, the following extracts from the First Survey report,—page 569,—are introduced.

"At Lucinda furnace . . . the limestone is seen capping the hill, accompanied by the chert and iron ore. At the ore-bank about one and a half miles S. E. of the furnace, and near the level top of the hill, the stratification is as follows:

"Clay, covered with soil, from	4′ to 5′
Iron ore, from	6″ to 24″
Chert;	
Limestone.	

"The ore is variable in its characters, being sometimes a a solid, hard, blue fossiliferous stratum, looking like limestone, while at others it consists of crusts and shells, containing cavities and concentric nodules. These nodules are sometimes nine inches in diameter, and contain a yellowish nucleus, surrounded by a hard black crust a fourth of an inch thick. The chief part of the ore, however, does not consist of regularly formed nodules, but of small crusts which look like fragments of large masses, and break into small pieces. These frequently contain cavities filled with an unctuous dark colored fluid, which escapes when the shell is broken. The inside of these crusts is usually smooth, sometimes of a beautiful glossy black color, or covered with minute yellow, purple, or violet colored crystals: this is most common nearest to the chert. In the upper part of the ore stratum, the shells are much mixed with yellow clay, which itself contains much peroxide of iron. Between the limestone and ore lies the chert, which passes sometimes into one, sometimes into the other, in which latter case it is often highly colored by the peroxide of iron."

"On the hill opposite the furnace a coal bed [Clarion Lower coal] has been opened, from four to five feet thick, of good quality, and forty (? thirty) feet below the limestone, at the summit. The same bed is wrought one mile south of this. '

"On land belonging to Lucinda furnace, on Paint creek, two bogs have formed from ore issuing from beneath the Seral conglomerate, each covering half an acre of ground, and from two to eight feet deep. A bog, one third of a mile southeast of the Lucinda furnace, covers an acre of ground, and averages three feet in depth, while one of equal depth a mile north of the furnace covers from two to three acres."

§ 465. The following analysis of the Lucinda furnace ore is given on page 740:

Peroxide of iron,	78.22
Peroxide of manganese,	1.50
Alumina,	0.54
Water,	14.20
Insoluble matter,	4.80
Metallic iron,	54.75

"Chestnut-brown, cellular, burnt-stone ore."

§ 466. It may not be amiss to insert here a record of the *Snydersburg test well.* The location of this well,—lying as it does midway between Shippenville and the Cooksburg well on Tom's run in Farmington township,—makes the record of its drillings especially valuable and interesting to the geologist and also to the oil producer. It enables us to prove by a comparison of sections what we could not before clearly see in reference to the Clarion Oil Sand Group horizon in Forest county, to wit: That this group is there represented, as shown in the Marienville wells, by a band of measures characterized by containing a series of *red bands.* This record also shows that the Mauch Chunk red shale, long supposed to be absent from Clarion county, stretches half across the county. The well-mouth is situate about ninety feet more or less beneath the Ferriferous limestone.

§ 467. *Snydersburg well.*

Situated one mile east from Snydersburg. Authority, Dr. Towler.

Well mouth above ocean, (barometer,)	1470 (?)
Conductor,	14 to 14
Bluff sand,	156 to 170
Mountain sand,	70 to 240
Slate and shells,	60 to 300
RED ROCK,	7 to 307
Slate and shells,	282 to 589
Soft slate,	2 to 591
Pebble sand,	5 to 596
Shells, slate, and sand,	138 to 734
First sand,	30 to 764
Slate,	110 to 874
"Little" RED ROCK,	27 to 901
Second sand,	20 to 921
White sand,	5 to 926
"Big" RED ROCK,	40 to 966
Black slate,	50 to 1016
Stray sand,	17 to 1033
Third sand,	12 to 1045
Slate,	9 to 1054
Third sand,	11 to 1065
Slate,	35 to 1100
Fourth sand,	11 to 1111
Slate,	96 to 1207

Washington Township.

§ 468. This lies north from Elk and Knox townships, east of Venango, and east and south from Forest county.

It contains a high back-bone ridge, the *Allegheny-Clarion Divide*, which runs in a general northeasterly course, separating the drainage of Sandy creek, the two Hemlock creeks, and East Sandy from the southern drainage into Paint creek.

§ 469. *The highest land in Clarion county* is found near Fryburg, where the hills rise to a height of about seventeen hundred and fifty feet, by barometer, above ocean level. These hills are sharp, bold in contour, rising abruptly from the surrounding country, and giving to the approaching observer an impression of nearing some large watercourse.

I have been unable to discern any plausible reason or cause why these hills should have been preserved, while other parts of the dividing ridge on which they are situated have been planed down much lower without having been subjected apparently to any greater degree of ærial erosive action,—but if we can admit that the topography of this portion of Clarion county has been greatly modified or planed down by ice, then this peculiar topography is at once seen to be the result of two glaciers, or two branches of one glacier, one of which came across the ridge from the north and went down Paint creek, while the other coming across from Hemlock creek stretched over into the valley of East Sandy, or mayhap over-riding the next divide reached across into Little Deer creek.

§ 470. *The Freeport Lower sandstone* just caps the summits, but yielding easily to erosion makes no prominent topographical features.

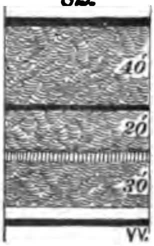
§ 471. *The Kittanning Upper coal* was not seen. *The Kittanning Middle coal* has been opened up and found to measure four or five feet, but its quality is very poor and all the banks upon it have been abandoned.

§ 472. *The Kittanning Lower coal* lies forty feet below the middle bed, and about twenty feet above the Ferriferous limestone. It is rather thin, measuring about two feet and six inches, but is of excellent quality. It is worked at several banks.

§ 473. *Fryburg Section:*

Kittanning Middle coal,	4′
Fireclay,	40′
Shale,	
Kittanning Lower coal,	2′ 6″
Fireclay,	20′
Shale,	
Ore,	1′
Ferriferous limestone,	5′
Shale, soft,	30′
Clarion Lower coal,	2′ 2″
Total,	105′

82.



The Ferriferous limestone outcrop girdles all the hills near Fryburg,. It ranges from five to six feet in thickness and is favorably situated for quarrying over a quite large area. It comes out in thin slabs, with characteristically irregular faces.

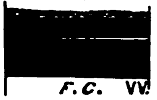
The iron ore is quite variable and seems to lie in "pots." It has been largely mined for the neighboring charcoal furnaces.

§ 474. A short distance west from Freiburg the *Clarion Lower coal* has been mined by stripping from an opening thirty feet beneath the limestone. It is about twenty-six inches thick and furnishes coal of reasonably good quality. One mile north from Lickingville either this bed or the Brookville coal is opened and worked by Mr. McMichael at a bank where the bed measures (Fig. 83):

§ 475. McMichael's coal bank:

Slate roof.	
Coal,	1′ 0″
Slate,	1½″ to 1″
Coal,	1′ 10″ to 2′ 0″
Fireclay floor.	

83.



This coal burns well but is somewhat troubled by thin pyrite layers disseminated through the bed. The same coal is also opened and worked at a bank on the Near heirs' estate, one half mile north from McMichael's bank.

§ 476. Between Fryburg and Lickingville are several old diggings on the Ferriferous limestone and its suprajacent ore-bed. These are the Clinton furnace workings.

Farmington Township.

§ 477. This lies at the northeastern corner of the county, adjacent to Forest county, along both its north and east lines; it is next east from Washington township, and north and east from Knox and Highland, and north and west of Mill Creek township, from which it is separated by the Clarion river.

It is the largest township of Clarion county, measuring nearly eight miles in breadth and length.

The Allegheny-Clarion Divide,—the "*Big Level*" of Forest and McKean counties,—runs through east by north, passing close to Tylersburg and North Pine Grove, and running out into Forest county, along the Marienville road. Its summits range from 1600 to 1700 feet above ocean level.

§ 478. *The Brady's Bend anticlinal* just touches the southeastern corner of the township, quickly passing over into Forest county, a short distance from Cooksburg.

The Brady's Bend synclinal is found near Scotch Hills, where it brings the Ferriferous limestone down low enough to be caught by the highest summits. It passes out of the township, near the middle of its east line. The Millerstown anticlinal was not actually detected in this township, but if it be prolonged northeasterly from Snydersburg parallel to the Brady's Bend axis, we find its crest passes about one mile east of Tylersburg and crosses the township's north line about one mile and a half west of the northeastern corner of the county. This is evidently its true position, for the Clarion coal found at Tylersburg has undoubtedly been preserved from erosion by the presence of a *synclinal* flexure, which can only be the *Millerstown synclinal;* the anticlinal should, therefore, be found a short distance *east* of Tylersburg.

§ 479. With the exception of small areas of the coal measures at Tylersburg and Scotch Hills, and also possibly at North Pine Grove, the surface is occupied by rocks of the Conglomerate series, which have produced miserably stony land, and a poor sandy or cold clayey soil, emphatically unfit for growing anything but timber.

§ 480. *Oil.*—Two wells have been unsuccessfully drilled for oil near Cooksburg. One of these is situated on Tom's run, one hundred and ten feet above the Clarion river, at Cooksburg, and three hundred feet, more or less, below the Ferriferous limestone. The following record of the rocks pierced by this well was kindly furnished by Maj. Cook.

§ 481. *Cook Well, No. 2.*

On Tom's run, two miles northwest of Cooksburg.

Well mouth above ocean in feet,	1260±
Conductor,	22 to 22
Interval,	21 to 43
Mountain sandstone,	121 to 164
Slate,	56 to 220
Yellow sandstone,	5 to 225
Slate,	27 to 252
Sandstone; close,	20 to 272
Slate and shells,	8 to 280
Sandstone; close,	39 to 319
Slate,	10 to 329
Pebbly sandstone,	31 to 360
Slate,	110 to 470
Interval,	29 to 499
RED ROCK,	11 to 510
Slate,	40 to 550
RED ROCK,	18 to 568
Slate,	22 to 590
RED ROCK, (shells at 635', 650', 675',)	135 to 725
Slate,	43 to 768
Sandstone,	16 to 784
Slate,	42 to 826
RED ROCK,	17 to 843

The Mauch Chunk red shale is not noted in this record, but that is no proof that it is absent, for it might easily have been overlooked by the driller. Its horizon is probably in the unnamed interval of twenty-one feet. The outcrop of this formation has been marked on the geological map, but such representation is necessarily more or less suppositious, as it is impossible to actually trace it, owing to the hillsides being covered with a talus of rock from the overlying conglomerate measures.

§ 482. Nearly all the good *timber* has already been cut and what remains will soon be exhausted.

§ 483. At and in the hills surrounding Tylersburg a thin coal is opened up and mined at a number of banks. It is overlaid by about thirty-five feet of soft, shaly measures which however contain no traces of limestone. This bed is apparently the *Clarion Lower coal*, but it may possibly be the *Brookville bed.* It ranges from two feet three inches to two feet nine inches, averaging about two feet and six inches, with no parting layers. Though quite free from slaty impurities it is rather sulphury.

§ 484. A coal has been opened and mined for a number of years at North Pine Grove, in the northeastern part of the township, which is said to be much better than the Tylersburg coal. It measures variably from two to three feet. Whether this coal is the Clarion bed or one underlying the Homewood sandstone is yet an open question. From its elevation we should judge that it belongs in the *Mercer* horizon, but its associations and the character of the coal seem to indicate that it is identical with the Clarion, or possibly the Brookville bed.

§ 485. *The Ferriferous limestone* is found at Scotch Hills in three round-tops covering an aggregate available area of one hundred and fifty to two hundred acres. It is four or five feet thick and carries on top both carbonate and altered carbonate (hematite) ore, some of which is often found filling the crevices of the limestone.

The Clarion coal, three feet thick, is mined at several banks situated, on an average, twenty-eight feet beneath the limestone. It is somewhat sulphurous.

The Brookville coal is too thin to mine.

§ 486. A thin coal has been opened up one hundred and fifty feet, more or less, beneath the limestone, which is remarkably free from sulphur and has been successfully used for smithing. It measures about fifteen inches.

As the *Ferriferous limestone* has only fifteen or twenty feet of cover, the hilltops are not high enough to catch the *Kittanning Lower coal.*

§ 487. *The Brookville coal*, nearly three feet thick and of fair quality, has been opened up by Mr. Bartlett at a bank one mile north of Scotch Hills. The bed has very little cover, and is found over an extremely small area.

§ 488. The following extracts from the First Survey Report, pages 567–8, are valuable in that the exposures described cannot now be satisfactorily examined.

"The Clarion [Lower] coal bed at its outcrop on Leach's farm, in Farmington township, is four and a half feet thick, and good ; roof brown shale, four feet. Again, three and a half miles to the southeast it is four feet thick, good, but slightly pyritous. Again, one mile to the east it seems to be but two and a half feet thick; quality good: the roof is shale, twenty-five feet thick.

"The Brookville coal is here traced with difficulty.* It is seen two miles north of Leach's, from eighteen to twenty inches thick; thirty or forty (?) feet of brown shale and argillaceous sandstone [Clarion SS.] lie between it and the Clarion [Lower] coal, and a few feet of the same rock below it, to the Tionesta sandstone."

§ 489. "*Bog Iron-Ore.*—The base of the Seral conglomerate [Connoquenessing Upper or Lower sandstone] is the position at which we find the chief bog-ore deposits of the Clarion. Several of these deposits occur in the vicinity and on the west side of the Clarion in Farmington township, and are worthy of notice. They are about a mile below the mouth of Laurel run, and upon the opposite side of the river, between two small streams, from five to ten acres are covered with this ore. The deposit at Alsbachs' is said to be three fourths of a mile long. Two miles north of this there is another extensive deposit of the same iron-ore. On the opposite side of the Clarion, up Laurel run, there are several other deposits more or less extensive."

---

* Because it is usually replaced by the Homewood (Tionesta) sandstone, which is seldom low enough beneath the Clarion coal to admit this bed.

CHAPTER VIII.

The Clarion Oil District.

§ 490. The outline map of Clarion county (Plate IV) shows by as tippled area the extent of the Clarion Oil Belt as at present developed. But it must not be assumed that all the shaded territory is or has been actually productive, for this is not true; the productive oil rock is found only in "streaks" and patches more or less completely isolated from each other by bands of hard fine-grained sandrock, from which little or no oil can be obtained.

§ 491. *The total area* included within the extreme limits of the outlying productive patches, as shown upon the map, is about 20,560 acres, or somewhat more than thirty-two square miles, whereas the total *productive acreage** is about 7,000 acres, or somewhat less than eleven square miles, with an included unproductive area of 13,560 acres.

§ 492. *The Oil Rock*, or "*Third Sand*," as it is usually called, is a loose-grained, yellowish sandstone, the grains of which are ordinarily from the size of a pin's head or smaller, to that of a pea; with a very small amount of cementing material. Such a rock guarantees a paying well, but it sometimes happens that the sand is fine and close, of a greyish color, and bound tightly into dense rock by a considerable amount of cement. Such is the character of the sandrock along the unproductive bands or "*dry streaks.*"

---

* Caldwell's Clarion County Atlas.

§ 493. *The dip of the oil rock* is not constant. The direction of strongest dip is usually a few degrees west of south, but local synclinal and anticlinal axes may often cause great variations in both its direction and strength.

The following figures show the elevation in feet above ocean level of the top of the oil sand at the principal towns along the oil-belt:

Shippenville,	370′±
Edenburg,	325′
Beaver City,	225′
Dogtown, (Monroeville,)	230′
Turkey City,	220′
Emlenton,	130′±
Foxburg,	100′
Parker,	60′

The oil sand at Dogtown is exactly the same distance above ocean level as the sandrock at Clintonville, in Venango county, on the Oil creek belt. A line drawn between these two places will, therefore, be a line of no dip, *i. e.*, the strike. The rate of descent along a line at right angles to the strike averages about twenty-three feet per mile.

The dip from Shippenville to Edenburg is 14′± per mile; from Edenburg to Beaver City, 40′ per mile; from Beaver City to Dogtown, 9′ per mile; from Dogtown to Turkey City, 10′ per mile; from Turkey City to Foxburg, 25′ per mile. The sharp dip of forty feet per mile from Edenburg to Beaver City is probably caused by the *north dip* of the Martinsburg synclinal.*

§ 494. *The Oil Sand Group*, in Clarion county, presents several features peculiar to itself, the most prominent of which is the occurrence of a thick band of red shale lying between the Second and Third sands. A section of this group at Edenburg, taken from a record kept by Mr. John H. Carll, is shown by Fig. 16:

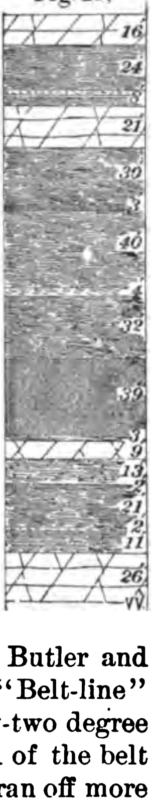
---

*This axis is described in Report V. on northern Butler county. It was not detected in the surface rocks of Clarion county, and has, therefore, been omitted from the map and text.

Oil Sand Group.

Sandstone,	Horizon of the First Sand,	16′
Slate,		24′
Shell,		2′
Red rock,		1′
Slate,		5′
Sandstone,		21′
Dark grey slate,		30′
Red rock,		3′
Dark slate,		40′
Shells,		4′
Slate,		32′
"*Big Red Rock.*"		39′
Slate,		3′
Sandstone,		9′
Slate, sandy,		13′
Red rock,		2′
Slate,		21′
Shells,		2′
Slate,		11′
Sandstone, "Third Sand,"		26′

Fig. 16.



§ 495. The Clarion county oil field, like the Butler and Armstrong districts, has been developed on the "Belt-line" theory. But it was soon found that the twenty-two degree bearing of the Butler oil-belt was not the trend of the belt in Clarion county; that the productive streaks ran off more towards the northeast, and from using lines bearing N. 22° E. the producers finally came to use lines running variably from N. 30° E. to N. 45° E. The straightest part of the Clarion belt is between Parker and St. Petersburg, but from the latter locality to Shippenville a very perceptible curvature exists.

As at first developed, in 1875–6, the belt was comparatively narrow, but subsequent operations, in 1877–8, proved the existence of several productive "streaks" and "pools" both north and south of the original developments. The whole field will undoubtedly be re-worked whenever the price of oil warrants additional drilling, and at such time it is not improbable that new productive areas of local extent may be found on either side of the present limits; but the main body of oil along this belt has already been nearly exhausted.

§ 496. *The further extension* of the belt seems to be entirely cut off by a thinning away (or fining down) of the oil sand at Shippenville. About fifty wells have been unsuccessfully drilled in search of an eastward prolongation beyond the Shippenville pike, but they have been confined to a comparatively small area. It is possible that an extension may yet be found in the northeastern part of the county. Some few wells have been put down in Knox, Washington, and Farmington townships, but they have been scattered at considerable distances from each other, and, therefore, their failure does not preclude the possible existence of productive territory.

§ 497. *Production.*—It is extremely difficult, if not impossible, to arrive at even an approximate estimate of the oil produced in the Clarion county district. The oil has been transported to the railroad by several different pipe lines, the old books of which have been stored in out of the way places, some of them lost, and others destroyed by fire. Again, much of the oil produced in early days near the river was loaded upon barges and sent directly to Pittsburgh and other refining centres; of this no statistics can be obtained.

In Caldwell's Atlas of Clarion County the following figures are given, but no mention is made of the source from which they were obtained:

Year.	*Barrels per diem.*	*Year.*	*Barrels per diem.*
1866, ...	8	1872, ...	3,000
1867, ...	20	1873, ...	4,000
1868, ...	80	1874, ...	4,500
1869, ...	100	1875, ...	5,000
1870, ...	200	1876, ...	6,000
1871, ...	500	1877, ...	6,500

Assuming the above table to be approximately correct, and estimating the daily production of 1878 and 1879, respectively, at three thousand and two thousand barrels, the total amount per year then stands:

Year.	*Production.*	*Year.*	*Production.*
1866, ...	2,920	1873, ...	1,460,000
1867, ...	7,300	1874, ...	1,642,500
1868, ...	29,280	1875, ...	1,825,000
1869, ...	36,500	1876, ...	2,196,000
1870, ...	73,000	1877, ...	2,372,500
1871, ...	182,500	1878, ...	1,098,000
1872, ...	1,098,000	1879, ...	730,000

Which foots up a total production to January 1, 1880, of 12,753,500 barrels. Although this is necessarily a very rough estimate, it serves to give a good general idea of the productiveness of this territory. If we assume that a total production of 14,000,000 barrels will eventually be obtained from the area now developed, which has been estimated at 7,000 acres, we find that the average yield per acre is 2,000 barrels, which is equivalent to a layer of oil about $3\frac{1}{6}$ inches deep evenly distributed over that area.

Now the measure of the productiveness of an oil sand is its porosity, and to this there are definite mathematical limits. If an oil-rock is composed of loose spherical sand grains with no cementing material, the ratio of the solid matter to the interstices is always the same, no matter what the coarseness of the rock, provided its grains be of uniform size, for if these be packed as loosely as possible, each grain touching only six other grains, then the porosity may be expressed thus:

$$D^3 - \frac{3.1416}{6}D^3 = X; \quad \text{or,}$$
$$1 - .5236 = .4764$$

—this being the *extreme limit of porosity* in any sand-rock containing spherical grains. But it is evident that the ratio of unoccupied space to solid matter is usually much less;

for the sand-grains will not lie as cubes piled one on the other, but will settle down into a compact mass, just as cannon balls are piled together, with only $\frac{1}{5}$ void and $\frac{4}{5}$ solid matter, or more accurately .2010, which is the minimum limit of porosity when the sand grains are of uniform size.

In Trautwine's engineers' pocket-book we find "ordinary pure sand . . . dry and loose, . . . voids were .410. By thorough shaking and jarring . . . its voids were .320." "Another pure quartz sand of *much finer grain*, . . . dry and loose, . . . the voids were .466. . . . . By thorough shaking and jarring . . . its voids were .384." "Another . . . *finest sifted grains* . . . its voids . . . were very nearly .500." These figures agree remarkably well with the theoretical limits first stated.

The actual porosity of an oil-rock must necessarily be less than any of the above figures; for the sandstone is always composed of grains differing in size. Assuming that a given rock contains sand grains of two distinct sizes—large pebbly grains and very fine grains—its porosity may be theoretically estimated thus:

The greatest porosity with spherical grains of uniform size is .4764, the minimum porosity .2010, and the mean .3387, which we may assume as the percentage of space between the larger grains: but these latter interstices *are filled with finer grains* which also have a ratio of solid matter to void of 1. : 0.3387, and the true ratio of solid matter to void in the sandrock must therefore be,

$$1.0000 : (.3387 \times .3387) = 1147.$$

or in other words the porosity amounts to about $\frac{1}{8}$ of the bulk of the rock. This estimate excludes the presence of any cementing (calcareous) material which is always present in greater or less quantity and which may very greatly reduce the amount of unoccupied space, so that it is hardly allowable to estimate the porosity at more than $\frac{1}{12}$ or $\frac{1}{15}$ of the total rock volume even when the sandrock is extraordinarily productive.

§ 498. If the porosity be estimated at $\frac{1}{15}$, all the oil produced in Clarion county could have been obtained from an average thickness of 4 feet (48 inches) of productive sandrock. But the oil-rock is generally ten, fifteen or twenty feet thick and we should therefore expect a production equal to a depth of twelve or fifteen inches instead of 3⅛ inches as shown above. It does not seem improbable that the rock does actually contain much more oil than the driller is able to obtain from it, for the oil only runs into the well by reason of pressure from the imprisoned gas, (gravity helping it very slightly,) and when this pressure is too weak to overcome the capillary attaction, which holds the oil as water in a sponge, then no oil can be obtained: the finer the grain of the sandrock the greater will be this capillary attraction; and we can easily understand how millions of barrels of oil may thus be held imprisoned in a rock too fine grained to yield it up.

The cost of the oil produced in Clarion county may be approximately estimated. About 2500 wells, at an average cost of $3000, have been drilled and operated for an average period of three and a half years at a cost of nearly $500 per year. Assuming that each well paid for itself in oil produced within two years, the cost would then amount to the money invested, plus interest for two years on the first cost, and for one year on the expense of operating, thus:

Cost of 2500 wells @ $3000, ...	$7,500,000
Interest for two years @ at 6 per cent.,	900,000
Operating 2500 wells 3½ years @ $500, .	4,375,000
Interest on $1,250,000 for 1 year @ 6 per cent., ...	75,000
	$12,850,000

This then is the first cost of 12,753,500 barrels of oil: almost exactly one dollar per barrel. When oil is worth less than one dollar there must of course be an actual loss to the producer.

§ 499. The chief characteristic of the Clarion oil-belt has been the approximate uniformity in the size of its wells, the large majority of which when first struck produced from ten to thirty barrels per diem. Wells flowing from one hundred to one hundred fifty barrels have occasionally been obtained, but this territory has produced no "gushers" like the Bullion district or the Butler county Fourth Sand belt flowing from one to three thousand barrels per day.

§ 500. *The life of these wells* has been nearly equal to the average life of the Butler county wells; but as the price of oil is always a factor in the productive life of an oil well, and as the two districts were not developed simultaneously, such a comparison is worthless.

Within the last year (1878–79) hundreds of wells have been abandoned; and in a large number of instances the well fittings and engines were transported to the Bradford field. This has been caused principally by a rapid decline in the price of oil. With oil at two or three dollars per barrel, wells yielding from one-half a barrel to one or two barrels a day can be pumped at a profit; but when the price falls to seventy or eighty cents per barrel these are necessarily abandoned.

CHAPTER IX.

The Charcoal Iron Furnaces.

§ 501. Reference has already been made to the influence of the iron industry in hastening the settlement and increasing the population of Clarion county.*

The earliest furnace of which we have any trustworthy record, is the Shippenville stack, which was built in 1832, with 9-foot bosh and 32 feet high. From this time until 1856 stack after stack was built and put in blast, until the county contained more than thirty furnaces. These were nearly all built of rough stone, faced only on the edges and generally keyed with wooden cross-beams.

§ 502. Though all these stacks were built for cold blast, many of them were subsequently altered to hot-blast. This change was made between 1854–7.

§ 503. It is extremely difficult to arrive at even an approximate estimate of the iron produced by these furnaces. In 1856 a production of 20,368 tons can be summed up from 18 furnaces which were in blast an aggregate of about 660 weeks. This shows an average of 30½ tons per week of pig metal for each stack in blast; but some were making fully 50 tons, while others were doing little more than 20 tons. The total production of charcoal iron in northwestern Pennsylvania in 1856 was 59,388† tons. Assuming the above figures to be correct, it is seen that more than one third the whole amount of charcoal iron made in northwestern Pennsylvania in that year was produced in Clarion county. In 1854 this ratio was probably fully one-half. At this date a gradual decline set in, and in 1866–7 nearly all the furnaces had been abandoned. Several causes contributed to this result, viz:

1st. Exhaustion of timber.

2d. Increasing cost of ore from long hauls.

---

*See page 4, chapter I.

† North American Gazette, February, 1858.

3d. Exhaustion of the peroxide (altered carbonate (ores.

4th. Increasing cost of ore from long drifts.

5th. Decline in the price of iron by competition of large anthracite and coke stacks.

These factors in the life of the individual charcoal stacks will be considered more in detail under the head of "Fuel" and "Ore."

§ 504. No more favorable conditions for the successful career of a charcoal stack can be imagined than those obtaining when the first furnaces were built. They had an abundant supply of easily accessible carbonate ore, averaging 33 per cent. metallic iron, and remarkably free from phosphorus and sulphur, with often large bodies of it partly altered to peroxide of iron, and therefore much richer in iron; immediately beneath it a pure bed of limestone from five to twenty feet thick, while in every direction immense stretches of timber insured fuel for at least a reasonable length of time. Those situated near the Allegheny river had only to haul their pig metal to it for transportation by barges to Pittsburgh or points on the Ohio or Mississippi valleys.

§ 505. *Fuel.*—All the charcoal used by these stacks was charred in open heaps; the wood being built in a dome shaped pile and covered with earth, or a mixture of earth and charcoal dust, and sometimes, though seldom, with sod. The wood was either piled vertically with the large end of each billet down, a few horizontal layers being added on top to finish the heap; or after starting the heap as at first it was finished by a series of horizontal layers arranged like the spokes of a wagon-wheel and finished as before. The heaps ordinarily contained from twenty to forty cords.

The percentage of charcoal obtained from a given amount of wood necessarily varies with the season, age of the wood and the atmospheric conditions as well as by the experience or ignorance of the burner. Twenty pounds of charcoal for every one hundred pounds of wood is probably a fair average estimate. The following table taken from Overman's "*Manufacture of Iron*," page 115, embodies the results of several experiments with different kinds of wood.

It shows the weight of charcoal obtained from one hundred pounds of wood.

Chestnut,	23.2
Oak,	22.6
Walnut,	20.6
Beech,	19.9
Pine,	19.2
Ash,	17.9
Birch,	17.4

The Clarion county furnaces generally consumed from one hundred and seventy-five to two hundred and twenty-five bushels of charcoal for each ton of pig-metal produced.

A large number of stacks were abandoned only because their timber supply had run short and the price of iron did not warrant a continuation of operations when charcoal could not be obtained without hauling it several miles.

§ 506. *Ores.*—Four ore horizons have been successfully worked in this county, they are:

1st. Freeport Upper ore.
2d. "Limestone" or "Buhrstone" ore.
3d and 4th. Two beds of the Mercer horizon.

But besides these there are two other ore beds which have not been worked, viz: The Freeport Lower ore and the Johnstown Cement "limestone" which is here a calcareous ore.*

The Freeport Upper ore occurs in the shales underlying the Freeport Upper limestone, and is present either as ball-ore or as a compact band of plate-ore in all the high knobs of Perry and Madison townships. The old workings on it have probably nearly exhausted these areas which are at any rate very small. This ore is not as pure as the buhrstone bed.

§ 507. "*Buhrstone*" or "*Limestone*" *ore.*—This lies immediately upon or a few feet above the Ferriferous limestone, presenting an outcrop nearly co-extensive with that stratum. The workings upon it have been more numerous than, extensive for most the diggings are merely outcrop openings and do not touch the great body of the bed. There is hardly a mile along its four hundred and fifty miles of outcrop in this county, but shows some trace of old diggings or prospecting holes.

---

*See page 43.

It has a mean average thickness of ten or twelve inches but may often swell to two or three feet and cases are reported where even six feet of solid ore has been found: but these are rare if not unique.

§ 508. The ball-ore usually distributed in the shale above always makes an important increase in the yield from outcrop diggings, but in drift miningit is of little consequence unless lying low down within a foot or two of the ore-band proper.

The following analyses of this ore though already printed in other parts of this report are here reproduced to show by comparison the really superior quality of this ore.

§ *509. Analyses of the Ferriferous Limestone Ore.*

	21.	*29.*	*31.*
Protoxide of iron, ...	44.357	38.571	48.535
Sesquioxide of iron, ...	2.857	2.142	1.101
Bisulphide of iron, ...	.109	.009	.491
Protoxide of manganese, . . .	2.101	1.756	1.282
Protoxide of cobalt, ...	trace.	trace.	trace.
Alumina, ...	.743	1.027	.528
Lime, ...	6.380	6.750	5.650
Magnesia, ...	2.248	1.992	2.396
Sulphuric acid, ...	trace.	trace.	trace.
Phosphoric acid, ...	.643	2.333	.277
Carbonic acid, ...	33.333	29.403	36.109
Water, ...	1.789	2.137	.711
Insoluble residue, ...	5.440	13.880	2.920
	100.000	100.000	100.000
Metallic iron, ...	36.550	31.500	38.750
Metallic manganese, ...	1.628	1.361	.994
Sulphur, ...	.058	.005	.262
Phosphorus, ...	.281	1.019	.121

No. 21. Sligo Furnace, "specimen more or less oxidized; calc-spar in thin plates; somewhat cellular, bluish and reddish-grey."

No. 29. Hindman's quarry; "Hard and tough, rather *coarse grained*, somewhat oxidized, bluish-grey."

No. 31. Fox farm, "*Very fine grained;* full of little pits, partially filled with calc-spar, rather tough and hard bluish grey."

A series of analyses of this carbonate ore is given in the final report of the First Survey, Vol. II, page 740, as follows:

§ 510. *Analyses of Clarion county iron-ores.*

	A.	*B.*	*C.*	*D.*	*E.*	*F.*	*G.*
Carbonate of iron,	76.30	87.04	. . .	. . .	25.80		
Peroxide of iron,	. .	. . .	78.22	76.10	45.04	79.20	83.00
Peroxide of manganese,	.50	. . .	1.50	. . .	1.00	1.00	2.00
Carbonate of lime,	6.00	4.06	. . .	. . .	1.78		
Alumina,	1.00	0.05	0.54	3.60	0.70		
Insoluble residue,	13.30	5.08	4.80	7.70	21.50	5.30	2.81
Water,	2.00	1.05	14.20	12.50	4.00	14.00	12.50
	99.10	97.28	99.26	99.90	99.32	99.50	100.31
Metallic iron,	39.03	44.14	54.75	53.27	45.03	55.44	58.10

A. Kutcher's,—"Buhrstone-ore, bluish grey, compact, conchoidal, spathose."

B. Kutcher's,—"Dull red, mottled, soft and porous outcrop ore."

C. Lucinda Furnace,—"Chestnut-brown, cellular, burnt-stone ore."

D. Madison Furnace,—"Dull brown, cellular, internally compact, burnt-stone ore."

E. Porterfield's Furnace,—"Reddish brown, oolitic, nodular, concentric crust."

F. Porterfield's Furnace,—"Brown, slightly cellular."

G. Deal's bank, near Shippenville,—"Purplish-brown, hæmatitic, cellular."

Many of the above analyses were evidently made from outcrop ore nearly altogether altered to hematite, and some of these specimens had evidently been calcined. The true carbonate ores always required roasting, which was done in the same way that lime is calcined in open heaps mixed with charcoal, wood or bituminous coal. The latter is objectionable on account of the sulphur which it may remain. The roasted ore was always screened to remove dirt, ash and ore dust.

§ 511. A pure carbonate ore does not always work well in a charcoal stack, and for this reason as well as the increased cost of drift mining, most the ore used by these furnaces was the soft partially altered outcrop ore. When first put in blast all the stacks had an abundant supply of this cheaply obtained high grade ore, but as the diggings were gradually pushed farther and farther from the tunnel head, the ore cost increased until at last a haul of three or four miles of both the charcoal and ore was so expensive that no profit could be realized. This is undoubtedly one reason why nearly all the furnaces were abandoned before the timber supply was entirely exhausted.

A large quantity of the unaltered carbonate has been mined by drifts, as for instance at the workings of St. Charles furnace and at Lawsonham, but the cost of mining from a bed ten inches thick is greater than a charcoal stack can bear, unless it be very favorably situated with reference to timber, water power, transportation to market, etc.

§ 512. *Flux.*—The Ferriferous limestone always supplied a pure cheaply quarried flux. Analyses of this stratum will be found in § 122, and a description of it in § 117–§ 121.

§ 513. Within the last two or three years a large demand for these native carbonate ores has sprung up at Pittsburgh and other neighboring iron centers, for use with the high grade Lake ores. The effect of mixing these two ores is a corresponding increase in the run of iron, with an accompanying decrease in the amount of flux required. The Clarion county ores may possibly be largely worked to meet such demand, and if, after thorough trial has been made, their use is found advantageous, an immense mining field containing millions of tons of untouched carbonate ore can be easily and cheaply developed. But while this industry may eventually prove profitable, there is no future for the county as an iron-making center; no wood is left for the charcoal furnaces, and there are no tracts of coke-making coal of pure enough quality and of sufficient extent to warrant the erection of large furnaces.

§ 514. The following description of the individual charcoal stacks of Clarion county is nearly an exact reproduction from the *Iron Manufacturers' Guide*, by Prof. J. P. Lesley, then (1858) Secretary of the American Iron Association.

§ 515. *Catfish steam cold-blast charcoal furnace*, at the mouth of Catfish run, in Madison township. Built in 1846, and is 8 feet across the bosh by 30 feet high. It made, in 33 weeks of 1856, 925½ tons of metal from carbonate and bog-ores. Owned by Alex. Miller, and leased by J. L. Miller when in blast.

§ 516. *Pike steam hot-blast charcoal furnace*, on Lawsonham creek, three fourths of a mile from Lawsonham, in Madison township. Built in 1845, is 8 feet bosh by 30 feet high, and made, in thirty-six weeks of 1856, 1012 tons of iron. Originally built as a cold-blast stack. Blown out in 1866–7; now entirely dismantled.

§ 517. *Wildcat steam cold blast charcoal furnace*, on Lawsonham run, one mile from Reimersburg, in Madison township. Built in 1843, and is 7½ feet across the bosh by 28 feet high. It made 1380 tons of metal in 1856, was blown out in 1857, but was not finally abandoned until 1863. Owned by Miller and Freeman.

§ 518. *Black Fox steam hot-blast charcoal furnace*, on Black Fox run, one mile from the Allegheny river, at Upper Hillville. Built in 1844; is 9 feet across the bosh by 30 feet high, and made, in thirty-five weeks of 1856, 1353 tons of metal.

§ 519. *St. Charles steam charcoal, coke, and raw-coal furnace*, on Leatherwood creek, three miles from the Low Grade railroad, in Porter township. Built in 1844; is 10 feet bosh by 33 feet high, and made, in fifty weeks of 1856, about 2000 tons of forge metal. Built by Samuel Wilson, Esq., but purchased in 1845–6 by Mr. Patrick Kerr, who ran it until 1861, when it was leased by Mr. David McCue, who managed it until 1865, when it was blown out and abandoned. Hot-blast introduced about 1857. It is now owned by Howley, Reid, and Gillespie.

Though essentially a charcoal stack, this furnace was run for one year on coke made from the Freeport Lower coal, and for nearly a year on raw coal from the Freeport Upper bed, which, in this vicinity, is of a "*block*" character. Innumerable thin layers of mineral charcoal disseminated through the bed, divide the bituminous portion into such thin laminæ that any appreciable swelling or melting of the mass is rendered impossible, and each lump preserves its shape until entirely consumed.

§ 520. *Prospect steam cold-blast charcoal furnace*, on Cherry run, one mile south of Callensburg, in Licking township. Built in 1845; 8 feet bosh by 30 feet high, and made in thirty-nine and a quarter weeks of 1856, 1450 tons of mill iron.

§ 521. *Buchanan coal-blast charcoal furnace*, on the Clarion river at Callensburg, in Licking township. Built in 1844; is 8 feet bosh by 30 feet high, and averaged 1200 tons a year. Dismantled since April, 1856. Its timber is exhausted.

§ 522. *Sligo steam cold-blast charcoal furnace*, owned by Lyon, Shorb & Co., on Licking creek, near Sligo, in Piney township. Built in 1845; is 9 feet bosh by 32 feet high, and made, in forty-three weeks of 1856, 1998 tons of rolling mill iron. Changed to hot-blast in 1857.

§ 523. *Madison steam cold-blast charcoal furnace*, on Piney creek, two miles from the Clarion river, in Piney township; owned by Lyon, Shorb & Co. Built in 1836; 9 feet bosh by 32 feet high, and made, in forty-five weeks of 1856, 2140 tons of mill metal.

§ 524. *Martha steam cold-blast charcoal furnace*, owned by Lyon, Shorb & Co., near Reidsburg, in Monroe township—sometimes called Polk Furnace. Built in 1845; is 9 feet by 30, and made 1260 tons of metal in 1854. Its timber was exhausted in 1856.

§ 525. *Monroe cold-blast charcoal furnace*, on Piney creek, near the east line of Monroe township. Built in 1845; is 8 feet bosh by 30 feet high (inside), and made 393½ tons of metal in eighteen weeks of 1855.

§ 526. *Washington steam coal-blast charcoal furnace*, on Piney creek, east of Reidsburg, in Monroe township. Built in 1846; is 8½ feet bosh by 32 feet high (inside). Abandoned in the spring of 1855, having made 706 tons that year.

§ 527. *Limestone cold-blast charcoal furnace*, on Piney creek, in Limestone township. Built in 1845; is 8 feet wide across the bosh. Was abandoned in 1853.

§ 528. *Clarion cold-blast charcoal furnace*, on the Clarion river, one and a quarter miles northwest of Clarion. Built in 1848; is 8 feet bosh by 30 feet high, and has been abandoned since 1850, for want of ore; timber being abundant up to 1860, or later.

§ 529. *Richland steam cold-blast charcoal furnace*, on Turkey run, two miles from St. Petersburg, in Richland township. Built by Mr. John Keating, in 1846; is 8 feet bosh by 30 feet high, and made, in 1854–5–6, an average of 550 tons per year.

§ 530. *Stapley steam cold-blast charcoal furnace*, owned by R. & C. Shippen. Built in 1854, is 8 feet across the bosh and 30 feet high, and made regularly 1000 tons per year.

§ 531. *Jefferson steam hot-blast charcoal furnace*, on Beaver creek, at Jefferson station, in Beaver township. Built in 1838 and was run very irregularly, abandoned for want of timber. Is 8 feet bosh by 33 feet high, and made in 1856 about 600 tons of forge metal out of limestone and bog ores.

§ 532. *Eagle cold-blast charcoal furnace*, on Canoe creek, one mile from the Clarion river, in Beaver township. Built in 1846, is 8 feet bosh by 30 feet high and made from 700 to 800 tons per annum from altered (outcrop) carbonate ore.

§ 533. *Tippecanoe steam and water cold-blast furnace*, on Canoe creek, one mile above Eagle furnace, in Beaver township. Built in 1844 by Black and Maxwell, and run by King and Maxwell until abandoned in 1851.

§ 534. *Beaver steam and water hot and cold blast furnace*, on Deer creek two miles from the Clarion river in Beaver township. Built in 1835, is 9 feet bosh by 33 feet high and made as much as 1500 tons in a year. Abandoned in 1854.

§ 535. *Shippenville hot-blast charcoal furnace*, at the junction of Deer and Paint creeks one mile southeast from Shippenville in Elk township. Built in 1832, 9 feet wide across the bosh by 32 feet high and made in forty-three weeks of 1856, 1229 tons of mill metal from ore mined near the furnace.

§ 536. *Mary Ann cold-blast charcoal furnace*, on Paint creek at the Clarion-Franklin pike crossing in Elk township. Built in 1844 and abandoned in 1851. Was 8 feet across the bosh.

§ 537. *Deer creek cold-blast charcoal furnace*, on Deer creek at the Clarion-Franklin pike crossing in Elk township. Built in 1844 and abandoned in 1851.

§ 538. *Elk cold-blast charcoal furnace*, on Deer creek one mile above Deer creek furnace in Elk township. Built in 1842, 7 feet bosh by 22 feet high and abandoned in 1855 for want of ore and fuel, having made about 400 tons per annum.

§ 539. *Lucinda hot-blast charcoal furnace*, on Paint creek in Knox township. Built in 1833, 8 feet across the bosh and 30 feet high, and made in thirty-one weeks of 1856, 995 tons of foundry metal. Timber scarce and furnace to be abandoned [1857].

§ 540. *Hemlock steam cold-blast charcoal furnace*, two miles north-west of Fryburg in Washington township. Built by McGuire and Fetzer in 1845, 7½ feet across the bosh by 30 feet high (inside) and made in forty weeks of 1856 about 910 tons of metal.

§ 541. *Clinton steam cold-blast furnace*, on Hemlock run in the extreme northwestern corner of Washington township. Built in 1841, is 9½ feet bosh by 33 feet high and made in forty-three weeks of 1856, 1620 tons of forge metal.

§ 542. *Licking cold-blast charcoal furnace*, near Lickingville in Washington township. Built in 1845, is 7½ feet bosh and 30 feet high inside. Was abandoned in 1856. It used to make about 400 tons a year.

§ 543. *Helen cold-blast charcoal furnace*, stands midway between Clarion and Scotch hills, in Highland township. Built in 1845, is 8 feet bosh by 32 feet high, and made in twenty-six weeks of 1856, 756 tons of iron. Now entirely dismantled. Property owned by Mr. Wilson.

§ 544. *Corsica (Mt. Pleasant) steam charcoal furnace*, on a run seven miles E. N. E. from Clarion and half a mile from the Clarion river in Mill Creek (?) township. Built in 1849, 8 feet bosh by 30 feet high, and made about 500 tons per annum.

INDEX TO VV.

I. Index to Geographical and Personal Names.

Page.
Albright's (S. N.) farm, 142
Allegheny, 67
Allegheny county, 27
Allegheny-Clarion dividing ridge, 16,152,155,168,169,180,182
Allegheny escarpment, 64
Allegheny gorge, 154
Allegheny mountains, (face of,) 7
Allegheny river, 1,16,28,40,67,117,124,152,154,168,201
Allegheny, great bend, 66
Allegheny river furnaces, 196
Allegheny valley, 18,19,76,118,119,151,152
Allegheny Valley railroad, 4,11,67,76,130,152
Allegheny water basin, 19
Alsbach's, 186
American Philosophical Society proceedings, 67
Anderson run, 128
Anthony's Bend; anticlinal; tunnel, 24,28; 26,87,91,94,95,98,138,140
Argyle, Butler co., 44
Armstrong county; Bostonia coal mines in; wells; 4th sand, 1
23,25,26,27,29,40,49,53,63,66,87,97;117,152,154; 34; 61; 86
Armstrong oil district, 189
Armstrong run, 67
Ashbaugh farm, 153,155
Ashburner, Mr., 13
Ashland; township, 16; 2,29,65,168
Barger, Phillip, 124
Barger's quarry, (No. 35 analysis,) 54
Barkhouse, Mr. Solomon, 111
Barnett (Daniel) farm, 159
Barnett and Smith, coal banks, 159
Barnett coal bank, 159
Bartlett, Mr., 185
Bear creek; ore analysis; Upper and Lower vein at Donnelly station, 20
117,136; 50; 118
Beaver City; Level of oil sand at ——, 5,157,162; 188
Beaver creek; charcoal furnace on, 16,125,155,156,168; 203

Page.
Beaver Falls, well in Beaver county, . . . 58
Beaver furnace, . . . 157,160,170,174
Beaver steam and water, hot and coal blast furnace, . . . 204
Beaver township; line; charcoal furnace, . . . 29
45,65,117,125,127,156,168,173; 155; 203,104
Beaver and Shenango valleys, (survey of ——,) . . . 60
Beel's mountain, . . . 156
Beer's coal bank, Fig. 61, . . . 130
Bennett's Branch RR.; elevations, . . . 4; 11
Best (J. I.) farm, . . . 159
"Big Level" of McKean and Forest counties, . . . 16,152,182
Black, Jacob, Jr.; farm, . . . 172; 172
Black furnace, . . . 170,174
Black's corner, . . . 157
Black & Maxwell, . . . 204
Black Fox run, (charcoal furnace on ——,) . . . 201
Black Fox furnace; steam hot-blast charcoal furnace, . . . 117; 201
Black Fox stripping, . . . 122
Blair's corner; 3 banks on road west from ——, . . . 157; 161
Blyson run, . . . 148
Bostonia coal mines, . . . 34,43,100
Boundaries of Clarion county, . . . 1
Bowersox, Mr., . . . 91
Bradford oil field, . . . 194
Bradley, Hess & Co., . . . 171
Brady's Bend, . . . 19; 34,40,67; 66,74,183
Brady's Bend Anticlinal; crest, . . . 23
24,27,28,66,68,69,73,76,84,128,135,140,144,146,183
Brady's Bend Synclinal, . . . 23,27,66,68,84,85,128,134,135,140,144,174,183
Brady's Bend Coal and Iron Co., . . . 66
Brady township, . . . 56,65,66,67
Brinker, Capt., . . . 43,46,91,101
Brinker (Jacob) farm, . . . 113
Brinker, Mr., . . . 97,102,103
Brinkerton, (Mr. Hamm's, near ——,) . . . 96
Brookville; —— in Jefferson co., . . . 25; 98
Brookville anticlinal axis, . . . 24,25; 98
Brookville well; wells, . . . 116; 58
Brookville (?) and Anthony's Bend anticlinal axes, . . . 98
Brundred, Benjamin, . . . 162
Brundred well, No. 4, . . . 58,162,164
Brundred & Marston; oil well, . . . 86; 85
Brush creek, . . . 135
Brush run, (mouth,) . . . 135
Buchanan furnace; cold-blast charcoal furnace, . . . 125; 202
Bullion district, . . . 194
Burn's coal bank, . . . 130
Butler county; district; oil belt; report on northern townships; wells, . 6
20,27,49,51,53,64,117,154; 189; 189; 188; 61,194
Caldwell's Clarion County Atlas, . . . 10,187,190
Callensburg, . . . 5,20,29,125,127

Page.
Callensburg ancient channel, ... 20
Callensburg; abandoned bend at ——, ... 28
Callensburg; charcoal furnace near, ... 202
Cameron county, ... 57
Camp Ridge farm, Elk township, ... 171
Canada, (eozoic rocks of,) 19
Canoe creek; charcoal furnace on, ... 16,156,157,168; 204
Carll, John H.; Report I.I.I., ... 58,113,161,162,188; 57
Catfish; coal bank; station; section; township, ... 66
67,68,69,71,75,76; 75; 75; 76; 28,46
Catfish run; furnace at mouth, ... 17,68,74,75,124,125; 201
Catfish steam cold-blast charcoal furnace, ... 201
Cavanagh, John, ... 160
Centreville, Armstrong county, ... 26,138
Centreville, Clarion county, ... 26
Centreville P. O., ... 138
Centreville (coal banks near), ... 26
Centreville synclinal axis, ... 24,26,87,88,90,138,140,141,146; 139
Charcoal iron furnaces, ... 195
Cherry run: charcoal furnaces on; oil well, ... 17,78,84,85,125; 202; 86
Clarion, ... 10,140,142,145,203
Clarion county, ... 13,17,20,21,23,26,27,29,31,33,49,51,55,136,144
Clarion county atlas; outline map, ... 10,187,190; 187
Clarion county wells, ... 13,61,187,189,190,193
Clarion county charcoal furnaces, ... 73,203,205
Clarion county lands, ... 108
Clarion county generalized section, ... 61,143
Clarion county axes, ... 23
Clarion township, ... 26,27,28,56,65,135,137,138,140,146,173
Clarion river, ... 10,16,19,27,
58,65,117,125,127,133,135,137,140,145,151,154,156,168,173,182,183,186,202
Clarion river channel, ... 19
Clarion river gorge, ... 128
Clarion river, furnace on— 203,204
Clarion. Pike between Corsica and ——, ... 145
Clarion-Franklin pike, ... 204
Clarion-Allegheny divide, ... 16,152,155,168,169,180,182
Clarion, Allegheny and Tionesta divide, ... 16
Clarion-Red Bank divide, ... 16,98,117,135
Clarion. Foxburg, St. Petersburg and —— RR., ... 153
Clarion Coal Co., Clarion township, ... 48
Clinger's, Mr., ... 111,112
Clinton furnace; workings, ... 205; 182
Clintonville, in Venango co., ... 188
Columbia Oil Co.'s well, No. 19, ... 60,162,164,166
Colwell's (Mr.) place; house, ... 20; 21
Cook well No. 2, (record), ... 183
Cooksburg; well, ... 7,17,27,58,146,183; 183
Coon creek, ... 16
Corsica; section, ... 16,25,26,138,140,142; 142

Page.
Corsica. Pike between Clarion and ——, ... 145
Corsica (Mt. Pleasant) steam charcoal furnace, ... 205
Courson, (G. W.), ... 85
Courson, Henry, ... 85
Courson coal bank, Fig. 31, ... 85
Court-house, Clarion, ... 145
Crawford county, ... 22
Cribbs (Mr.); farm section, ... 136; 137
Curllsville in Monroe township, ... 27,128,135
Date of incorporation, ... 1
Date of settlement, ... 2
Date run, ... 168
Deal's bank, ... 170,199
Deer creek; headwaters; furnace on, ... 16,156,169,173; 170; 204
Deer and Paint creeks. Furnace at junction of— 204
Delo, Messrs. Joseph & Amos, ... 160
Delo coal banks, ... 160
Disler's in Venango county, ... 55
Ditty's (Thos.) bank, ... 94
Dividing ridge between Allegheny and Clarion rivers, ... 154
Dogtown, (Monroeville), ... 161
Dogtown, level of oil sand at ——, ... 188
Dogtown, elevations of wells near Turkey city and ——, ... 14
Dogtown, elevations of wells between ——, Pickwick and Triangle, . . 15
Donnelly station, ... 118
Dougherty, Thos., ... 147
Dougherty's store, ... 147
Driftwood, ... 5
Eagle furnace, ... 157
Eagle cold-blast charcoal furnace, ... 204
East Brady, ... 28,67
East Foxburg, divide at ——, ... 154
East Sandy creek, ... 16,168,169,180,181
Easton, ... 125
Edenburg, ... 5,41,49,50,55,58,122,156,157,158,159,160,162,164,166
Edenburg section, ... 154,158
Edenburg, (level of oil sand at), ... 188
Edenburg, (elevations of wells near Pickwick and ——,) 15
Elk city, ... 5
Elk cold-blast charcoal furnace, ... 204
Elk county, ... 57
Elk township, ... 16,29,45,65,156,157,168,169,173,180
Elk township charcoal furnaces, ... 204
Elliot, Mrs., ... 125
Elliot coal bank, ... 126
Emlenton; level of oil sand at, ... 4,13,29,50,153; 188
Emlenton and Shippenville RR., ... 5,152,154
Emlenton, Shippenville and Clarion RR. [elevations], ... 12
Extension of Allegheny Valley RR., ... 4
Fairmount, (Red Bank twp.), ... 25,
43,44,46,65,90,91,97,98,99,100,103,104,107,111

Page.
Fairmount basin, 98,109,113
Fairmount Coal Co.; bank No. 1; No. 4, 38,
43,45,46,99,101,105; 39,100; 48,105
Fairmount lands, (contoured map of ——,) 103
Fairmount coal openings, 45
Fairmount, RR. at ——, 106
Fairmount section; north of ——, 99; 107
Fairmount synclynal; axis; basin; trough, 24,87,91,94,98,100,108,138
Farmington township, 1,2,16,27,45,55,63,65,146,152,174,182,186,190
Fetzer, McGuire and ——, 205
"Fifth axis" (see Brady's Bend anticlinal), 27
"Fifth basin;" [synclinal], 23; 25
"Fifth bituminous coal basin," 23
First Geological Survey Report, 133
Fisher P. O., 147
Fisher's corner, 146
Fleming, S. W., 140
Fleming coal bank, 141
Forest county; line, 17,27,179,180,182,183; 10
Forest county. "Big Level" of McKean and ——, 16,152,182
Fox, (Mr.); farm; section, 131; 132,199; 132
Fox coal bank, 131
Fox bank, Perry township, 48
Foxburg; level of oil sand at ——, 13,154; 188
Foxburg, Shippenville and Kane RR. (trial line) elevations, 13
Foxburg, St. Petersburgh and Clarion RR., 5,152
Foxburg, St. Petersburgh and Turkey city. [Elevations of wells between ——], 14
Frampton, (David,); place; bank; farm section, 126; 127
Frazier's (Geo.) quarries, 112
Freeburg, (erratum, should be *Freiburg* or *Fryburg*), 182
Freeport Lower coal mine, 103
Freeman, Miller and ——, 201
Frostburg, 26
Fryburg; section, 9,180,181,182,205; 181
Gillespie. Howley, Reid and ——, 202
Goheen (Mr.); coal banks; farm; house, 89; 35,36,37,39,90,89; 88,94; 95
Great Western Furnace property, 67
Greenawalt's (Peter) opening near Jefferson county line, 109
Greenland, (Mr.) 144
Greenville, 27,138
Hagerstown, 17,18
Haggerty, John, 77,93,123
Halfway house, 153
Hamm's house, 96
Haney well, 162,163
Hartwell & Co., 66
Heater's cross-roads, 152
Helen furnace; coal bank; section, 27,174,175
Helen cold-blast charcoal furnace, 205
Hemlock creeks (2), 180,181

Page.
Hemlock run; furnace on— 16; 105
Hemlock stream cold-blast charcoal furnace, 205
Hess, M. E., 171
Hess, Bradley & Co., 171
Highland township, 28,45,56,65,140,146,152,174,176,182
Highland township charcoal furnace, 205
Hilliard, John, 112
Hillville; section No. 24, 76,77; 77
Hindman, Albert, 141
Hindman's quarry; limestone quarry, 54,141,199; 142
Hoover, John, 82
Hope well record, 61,171
Howland, Mr. A. B., 86,113
Howley, Reid & Gillespie, 202
Huffman, Mr.; farm, 107; 108
Hulmes, Mr.; farm; place, 107; 108
Hunt & Towler well record, 62
Hutchinson, C. D., 75
Incorporation. Date of; act of, 1; 2
Ion coal bank, 147
Ion, Wm., 147
Iron manufacturer's guide, by J. P. Lesley, 201
James, Abram, 148
James well, 60,148
Jamestown, 16
Jefferson, 17
Jefferson county, 16,24,25,26,27,56,97,98,137,140,146
Jefferson and Forest county line, 17
Jefferson furnace, 5
Jefferson station, (charcoal furnace at), 203
Jefferson steam hot-blast charcoal furnace, 203
Johnston, Cambria co., 43
Johnstown cement bed, 43,64,103
Judy's run, 169
Kanney's run; headwaters, 169; 170
Kaylor city, 67
Keating, J., 203
Kellersburg anticlinal; axis, 24,26,68,87,96,138,140,146; 28
Kerr, Patrick, 202
Kiefer estate. (Bank on the ——), 136
King & Maxwell, 204
Kiser (J. H.) farm, 164
Knox township, 45,65,174,176,180,182,190
Knox township, charcoal furnace in ——, 204
Kolp's run, 168
Kribb's (Capt.) farm, 162
Kunselman, David, 111
Kutcher's, 199
Lake Erie, 20
Laurel run; mouth, 186
Lawrence county, 64

Page.
Lawrenceburg, (high flats north of ——), 20
Lawsonham, 5,24,27,28,68,71,72,73,200,201
Lawsonham creek (charcoal furnace on ——), 201
Lawsonham, diggings, 70
Lawsonham Junction, 10
Lawsonham run (charcoal furnace on ——), 201
Lawsonham section, 71
Lawsonham station, 72
Lawsonham synclinal; trough, 24,27,68,73,87,135,138,140,146; 24,146
Leach's farm, in Farmington township, 185
Leasure's run, 17,91,94
Leatherwood creek; charcoal furnace on ——, 17,26,96; 201
Lesley, Prof. J. P., 24,28,67,134,201
Licking creek; branches; valley, 16,20,21,125,127,128,134,135; 78; 84
Licking creek, charcoal furnace on ——, near Sligo, 202
Licking cold-blast charcoal furnace, 205
Licking township, 65,124,125,127,156
Lickingville, 182,205
Limestone cold-blast charcoal furnace, 203
Limestone township, 16,25,26,27,41,43,47,56,65,87,97,98,135,137,140
Little Deer creek, 169,181
Little Licking creek, 127
Little Sandy creek, 16,168,169
Logan, John, 122
Long Bend, 75
Long Point tunnel, 68
Long run; opening on; quarry on, 54; 95
Low Grade RR.; in Porter township, 4,24; 201
Low Grade, or Bennett's Branch RR., [elevations,] 11
Lowellville, Lawrence co., 63
Lower Hillville, 77
Lowrie, Mr.; coal bank; opening, 90; 91
Lucinda, 29
Lucinda coal banks, 177
Lucinda Furnace; section, 176,178,179,199; 177
Lucinda hot-blast charcoal furnace, 204
Lucinda P. O., 176
Lucinda charcoal stack, 177
Lycoming county, 57
Lyon, Shorb & Co., 134,202,203
Madison furnace, 120,133,136,199
Madison steam cold-blast charcoal furnace, 201,202
Madison township, 26,27,28,31,34,37,39,43,47,56,63,65,67,78, 87
Madison township, high knobs of ——, 197
Mariasville, 155
Marienville; road; wells, 27,28,29,61; 182; 58,179
Marston, (see Brundred,) 86
Martha steam cold-blast charcoal furnace, 202
Martinsburg; axis; flexure; synclinal, 49,50,122,136; 29; 30; 188
Mary Ann cold-blast charcoal furnace, 204
Matildaville, 199

Page.
Maxwell; Black and ——, 204
Maxwell; King and ——, 204
Mayville, 10,98
McCall's bank; coal bank, 48; 120
McClure's bank; coal bank; mine, 39; 93; 92
McCoy, Mr., 72
McCreath, Mr., 36,
38,44,45,47,54,70,74,79,80,81,83,89,90,92,93,95,101,102,
104,105,106,120,122,124,128,129,130,131,132,139,141,144
McCue, Mr. David, 202
McDowell coal bank, 157
McElhatten coal bank, 157
McGrew Bros.; well No. 4, 166; 164,166
McGuire & Fetzer, 205
McIlhatten farm, 166
McKean county, 28
McKean county. "Big Level" of —— and Forest county, 16,152,182
McKillip's place, 108
McKinley's farm; opening on ——; land, 94; 92
McMichael, Mr.; coal bank; station, 182; 154
McNutt, Mrs., 91
McNutt's bank, 39
McNutt's farm, 94,95
Mechanicsville, 139
Mercer county section, 61
Mercer county Sharon block coal, 35
Methodist camping grounds, 85
Middle run; bed, 25,43,96,98,99,106; 106
Midland oil well; well No. 1, 60; 113
Mill creek; 2 forks; section, 16,140,146,155; 146; 147
Mill Creek township, 26,27,56,65,140,146,182
Mill Creek township, charcoal furnace in ——, 205
Miller, Mr. A. B., 148
Miller, Mr. Alex., 201
Miller, Mr. J. L., 201
Miller & Freeman, 201
Miller's Eddy section, 123
Millerstown, in Butler county, 29
Millerstown anticlinal; axis; minor axes, 24
29,176,183; 23,29,124,127,157,160,171,173; 29
Millerstown synclinal; axis; trough, 24,29,183; 23; 160
Millville; test oil well, 108,109,110,113; 113
Mineral run, 128
Mississippi valley, 196
Mobley, Major, 44,117
Mongtown, 168
Monroe furnace; cold-blast charcoal furnace, 136; 203
Monroe township; charcoal furnaces in ——, 16
41,47,65,87,127,135,137,140,173; 203
Monroeville (Dogtown); level of oil sand at ——, 5,161; 188
Monterey; road crossing, 29,117; 18

Page.
Mount Pleasant, 16
Murphy's bank, 39
Murphy, Mr. Robt., opening; coal bank, 78; 79
Murphy, T.; coal bank, 79
Narrow-gauge railroads, 5; 144,173
Natural gas springs, 74
Near heir's estate, 182
New Athens; specimen from ——, 74; 36
New Bethlehem; section, 34,88,90,91,92,94,95,97,100,103,115; 95, 88
New Bethlehem; Bostonia mines near ——, 43
Nicholson, R. J., 116
North Pine Grove, 68,182,183,184
Oak Vale school-house, 88
Ohio river; valley, 27; 196
Oil City, 4
Oil Creek valley, 18, 76
Oil well elevation in Clarion county, 13
Oil wells, 85
Oil Sand group, 189
Paint creek, 16,173,176,178,180,181
Paint creek; charcoal furnace on ——, 204
Paint creek; furnace at junction of Deer and ——, 204
Paint township, 27,45,56,63,65,135,140,152,156,173,174,176
Parker, 5,17,18,118,119,122,136,189
arker ancient water course near ——, 17, 21
Parker; level of oil sand at ——, 188
Parker, D., analysis, 50
Patton's station; section, 7,17,24,25,98,115; 116,116
Patton's station; Low Grade RR., near ——, 58
Perry township; high knobs of ——, 31
34,36,37,39,43,55,56,65,78,117,125,152; 197
Perryville; old channel at, 18; 20,119
Philadelphia and Erie RR.; elevations, 5; 13
Phillipsburg, 28, 66
Phipps, Mr. Harmer —— quarry, 168
Pickwick, 5
Pickwick; elevations of wells near —— and Edenburg, 15
Pickwick; elevations of wells between Dogtown, ——, and Triangle, 15
Pike furnace, 71,72, 73
Pike run, 72
Pike steam hot-blast charcoal furnace, 201
Pine run, 98,108,109,110
Piney creek; mouth; tributaries, 16,127,133,135,137; 129; 138
Piney creek; charcoal furnace on ——, 202,203
Piney township, 27,28,41,47,65,125,127,135,156,173
Pittsburgh, 4,27,190,196,200
Pittsburgh Coal and Mining Co., 75, 76
Platt, Mr. W. G., 23,25,26,43,58,94,103
Plyer farm, Toby township, 86
Polk furnace, 203

Page.
Porter towhship, 16,26,27,31,34,35,36,37,40,56,65,82,87,97,135,137
Porterfield's furnace, 199
Potts, Jos. D. Esq., ; Col, 86; 113
Proceedings Amer, Phil. Society 1865, 134
Prosius, Messrs. Watson & ——, 85
Prospect furnace, 120,125
Prospect steam cold-blast charcoal furnace, 202
Putney Bros., 119
Putney coal bank, 119
Queenstown, 67
Railroads, 4
Railroad elevations, 10
Ramsey's (T.) house; coal bank, 73; 74
Rankin's grist mill, 75,77
Red Bank, 4,28,46,66,68,71,72,76,78
Red Bank creek, 1,
10,16,17,23,24,25,27,45,46,59,67,68,87,89,97,98,106,112,113,115
Red Bank furnace, coal bank; mines; section, 34,70,133; 71; 77; 69
Red Bank junction, 17,24
Red Bank section, 67
Red Bank station, 68
Red Bank township, 25,26,31,34,35,37,38,40,41,65,97,98,137
Reichert's quarry, 37
Reichert's (J. M.) quarry, 122
Ried; Howley, ——, & Gillespie, 202
Reidsburg, 27,135
Reidsburgh; charcoal furnace near, 203
Reigel, Wm., 82
Reigel, Mr., 82
Reimersburg, 5,16,27,40,47,68,73,75,80,201
Reimersburg dividing ridge, 84
Reimsburg; test well near ——, 85,87
Reinzel, Mr., 111
Report I.I. 148
Richland steam cold-blast charcoal furnace, 203
Richland township, 16,65,117,125,152,154,156
Reigle's, Mr., 80
Riley, Mr., 139
Ritchie run, 1,2,155
Rockville, 96
Rush, A. W., 75
Salem, 16,155
Salem township, 16,65,155,156,168
Sandy creek, 180
Sarah furnace; coke yards and coal banks, 34; 77
Scotch hills, 29,183,185,205
Scrubgrass; bed; bend in the Allegheny, 49; 115; 28,29
Settlement of Clarion co., 2
Shannondale; section, 9,49,108,109,110,111; 109
Sharon section, 60
Shenango valley, 60

Page.
Shick, Mr., 108
Shippen, R. & C., 205
Shippenville; pike, 5,169,170,204; 170,173,190
Shippenville, devel. of oil sand at ——, 188
Shippenville; Emlenton and —— RR., 152,154
Shippenville furnace; well, 170,171,174,204; 172,179
Shippenville stack, 195
Shorb; Lyon, —— & Co., 134,202,203
Shoup, Mrs., 153
Shoup coal bank, 153
Sixth anticlinal; axis, (erratum, should be *fifth*, not sixth), 23; 23
Sixth bituminous coal basin, 23
Slapley steam cold-blast charcoal furnace, 203
Sligo, 5,28,45,46,58,84,126,128,130,134
Sligo Branch Coal Co., 47,48,82,83
Sligo branch coal banks, 83,84
Sligo Branch RR., elevations, 5,10,73; 12
Sligo Branch and Allegheny Valley RRs., 130
Sligo brick works, 130
Sligo furnace; property, 54,128,129,133,136,199,202; 93
Sligo junction, 24
Sligo section, 128
Sligo steam cold-blast charcoal furnace, 202
Sligo well, 61,134
Slippery rock creek, 64
Sloan bank, limestone township, 48
Sloan coal bank, 139
Sloan farm section, 138
Sloan (Mr.) house, 138
Sloan opening, 139
Smith (Daniel) farm, 159
Smith (John) well section, 61
Smith farm banks, 160
Smith & Barnett coal banks, 159
Smith Ferry, on Ohio river, 64
Smullen (W.) coal bank, 91,92,94, 96
Snake run, 155
Snyder coal bank, Fig. 56, 124
Snydersburg; well records, 179,183; 58, 61
Somerville; coal bank, (Fig. 28,) 44,45,81, 82
Songer (Mr. T. O.), coal bank, 48,110,111
St. Charles furnace and ore banks, 26,35,39,89,96,200
St. Charles coal mines, 94,96,200,201
St. Petersburg, 152,153,189,203
St. Petersburg dividing ridge, 154
St. Petersburg, Foxburg and Clarion railroad, 152,154
St. Petersburg well elevations, 14
St. Petersburg section, Fig. 73, 153
Stallman (D.), 147,148
Stevens coal banks and farm, 83,122,139,140
Strattonville, 142,146

Page.
Stutz machine, 38
Summerville (W.), 81
Susquehanna river exposures, 57
Switzer (L.) and bank, Fig. 51, 119,120
Taylor (R. D.), 116
Terwilliger's hotel, 146,147
Thomas farm, 92
Tionesta river, 16
Tippecanoe furnace, 16,157,204
Toby creek, 16,173,174,176
Toby township, *78,—27,28,31,34,37,39,40,43,45,47,56,65,68,87,117,125,127
Tom's run, 16,179,183
Towler (Dr.), 179
Town run, 17,25,49,98; 112,113
Triangle, 15
Troy, 25
Truitt's store, 112,113
Tunnel at Long Bend, 5
Turkey City; see *Wells*, 5,118
Turkey run, 16,73,118,119; 152
Turkey run; furnace, 154,155; 203
Tylersburg, in Farmington T., 16,29,182,183,184
Underwood, 148
Upper Hillville; furnace, 124; 201
Venango county, 1,20,22,29,49,50,122,136,155,168,169,180
Venango county map, 49
Warren county, 22
Washington furnace, 136,203
Washington township, *180,—16,65,169,182,190
Washington township furnaces, 205
Watson & Prosius' test well, 85
Wentling's corners, 157
West Freedom, in Perry T., 16,17,19,37,55,120,121,122
West Freedom section; analysis, 121,154; 50
Whiskey run, 67
White (Mr.), 27
Wildcat furnace and run, 68,72,73,78,82,118,201
Wildcat run section, Fig. 27, 81
Wilhelm (Jac.) coal bank, 107
Wilkins (Jas.) coal bank (McClure's), 88; 92,93,94,96
Will (Evan) coal bank, 97
Williamsburg, 28,136
Wilson (Jas.) (Sam.), 144,202,205
Wolf creek, 51
Worth (Dr. Otto), (erratum—should be Wuth), 117
Yingling (Harrison), coal bank, 120,121
Young (Sam.), coal bank, 143,144,145

II. Index to Geological References.

Page.

Abandoned water channels at Parker and Callensburg, 17,21
Absence of the Ferriferous limestone, from hills high enough to contain it, 140,142
  from all of Mill creek twp., 146
  produces poor soil, 169
Age of the Glacial epoch—(see also letter of transmittal), 20
Agriculture, influence of on growth of population,
Allegheny-Clarion divide (se Clarion-Allegheny divide).
Altered carbonate iron ore from outcrop workings used by charcoal furnaces, 200
Ancient water course at Parker, at Callensburg, 17,20
Anthony's Bend anticlinal, described, 24,26
  in Red Bank twp., in Porter twp., 98,87
  in Limestone and Clarion twps. near Corsica, 138,140
Anticlinals of Clarion county, apparent in Red Bank twp., 23,112
Area of Clarion county, 2
Axes, gentle in Limestone twp, minor roll in Venango county, 138,29

Base of the conglomerate series, discussed, 60,62
Beel's mountain, 1600 ± above ocean, 156
"Belt line" theory of the productive oil sand, 189
"Big level" (see Clarion-Allegheny divide) of McKean and Forest counties, termination in Richland twp., 16,152
Block coal from the Freeport Upper bed, 35,94,202
Bluffs along the Allegheny and Clarion rivers, 118
Bluffs of Homewood sandstone in Salem twp., 155
Bog iron-ore, at Lucinda furnace, 179
  from base of Homewood S. S. on Clarion river hillsides, 186
Boundaries of Clarion county, 1
Brady's Bend anticlinal, described;—on the Ohio river; in Allegheny and Butler counties; and in Forest county, 23,24,27
  elevates Homewood S. S. at Curllsville and Reidsburg in Monroe twp., 135
  lifts Homewood S. S. above water level in Piney twp., 128
  in Brady twp.; in Madison twp., in Toby twp., 66; 68; 84
  in Clarion twp. west of Strattonville; in Mill creek twp.; in Farmington twp., 140; 146; 183
Brady's Bend synclinal, described, 23,28
  in Brady twp.; in Madison twp.; in Piney twp., 66; 68; 128
  in Monroe twp.; east of Clarion in Clarion twp., 135; 140
  in Highland twp.; in Farmington twp., 175; 183
Brookville (?) anticlinal, described, 24,25
Buhr-stone iron ore (see Ore in Geological index).

Calc-spar with siderite in ball-ore over the Kittanning Lower coal, 140
Calc-spar in thin plates through ball-ore, 199
Callensburg old water channel, age of, 21
Cannel coal, in the horizon of the Clarion Lower coal, 94,95
  at Bostonia mines in Armstrong county, 103
Cannel horizon of the Lower Productive coal measures, 43
Cannel slate under Homewood sandstone, 72

Page.
Capillary attraction holding oil in sandrock when pores are small, ... 193
Carbonate iron-ore, average percentage of iron, ... 196
Catskill (see Red Catskill in Geological index).
Cementing material, small in good oil sand, ... 187
Centreville synclinal, described; in Armstrong county, ... 24,26,26
in Porter twp.; in Limestone twp., ... 87; 138
in Kitt. Lower coal; in Clarion twp.; in Mill creek twp., . 139; 140; 146
Charcoal; consumption of by furnaces, ... 197
Charcoal furnaces; number of men employed by; hot and cold-blast, . 4; 195
manner of building; production of iron by, ... 195
Charring wood, mode of piling, ... 196
Chert with the Ferriferous limestone-ore, ... 178
Clarion-Allegheny divide; high in Richland twp., ... 152
1475′—1525′ above ocean; in Ashland twp. 1500′—1575′ high, . . 154; 168
in Washington twp.; in Farmington twp. 1600′—1700′ high, . . 180; 183
Clarion oil sands the equivalents of the Pocono lower sandstone, ... 179
Clarion river,—character; fall of; basin of the, ... 17
Close approach of the Kittanning Lower coal and Ferriferous limestone, . 132
Coal,—preserved from erosion in the Millerstown synclinal trough at Tylersburg, ... 183
Coal beds caught in trough of synclinal, ... 98
Coal seam occupying the place of the Scrubgrass coal, ... 115
Coal supply,—of southern more certain than that of northern townships, 65
of Toby twp. amply sufficient for local demand; of Red Bank twp. ample; in Licking twp. enough for local consumption, ... 78; 98; 125
of northern townships; of Richland twp. sufficient for home use, 151; 152
of Beaver twp. enough; in Ashland and Elk twps. sufficient for local demand, ... 157; 168,169
Coke,—from Freeport Lower coal slack (analysis); from Kittanning Lower slack coal (analyses), ... 102; 106
Conglomerate,—recent, ... 18
Conglomerate sandrocks, probably shore or marginal deposits to the coal basin, ... 62
Copper—ore, ... 8
Correction of Sligo Branch RR. levels, ... 10
Crystalline structure in hollow ball iron-ore, ... 178
Crystals,—of siderite, pyrite and galena, ... 8
of siderite with calc-spar in iron-ore, ... 140
Crinoid stems in Ferriferous limestone, ... 158

Darlington coal,—(see Kittanning Upper coal in Geological index). .
Depth of Palæozic formations beneath water level in Clarion county discussed, ... 7
Dip,—rates of; of anticlinal and synclinal axes, ... 7; 23,30
general southerly dip of the surface rocks; into the Fairmount synclinal trough (note), ... 65; 109
strong southerly dip at Sligo (note); not sharp in Limestone twp., 134; 138
strong northwest dip into Brady's Bend synclinal near Clarion; westwardly dip in Beaver twp.; error in vertical section caused by dip, ... 145; 160; 123
Dip of the oil sand, ... 188

Page.
Distinction between sand pumpings from the Conglomerate and Pocono sandstones (note), ... 61
Divide between Deer creek and the Clarion river, 1450′—1500′ above ocean, 173
Divide in swampy ground in old channel near Hagerstown, ... 18
Dividing ridges of Clarion county, ... 16
Drainage, ... 16
Drift,—re-worked glacial and local, stratified, ... 18
  in side ravines left by Allegheny river as at Wildcat furnace (see prefatory letter), ... 118,119
Effect of mixing carbonate ores with high grade lake ores, ... 200
Elevations,—of Allegheny valley, low grade (Bennett's branch) and Sligo railroads, ... 11,12
  of Emlenton, Shippenville and Clarion, and Foxburg, Shippenville and Kane (trial line) railroads, ... 12,13
  of oil wells, ... 13,14,15,16
Erosion,—effect of anticlinal and synclinal rolls on the course of large streams, ... 5,28,127
  through drift; of Allegheny valley (see letter of transmittal), . . . 18,19
  of surface and valleys, disproportion between; through horizontal strata, ... 20
  unit of erosion; Subaqueous erosion of limestone by solution, . . 20,143
Error in vertical sections caused by dip, ... 123
Exhaustion of timber by charcoal furnaces, ... 195
Exposures of Conglomerate series rare, ... 17
Fairmount synclinal,—described, ... 25,26
  in Red Bank twp.; in Limestone twp., ... 98; 138
Fault in Kittanning Lower coal, between Clarion and Strattonville, (plate,) 144
Fifth coal basin, (see Brady's Bend Synclinal,) 23,24,27
Fireclay mined for firebrick at Sligo, (analysis,) 130
First charcoal furnace in Clarion county, ... 195
First oil wells in Clarion county, ... 119,152
Flats, broad, along the Clarion-Allegheny divide, in Salem twp., ... 155
Fluid in iron ore-balls, ... 178
Fossils in the Ferriferous limestone, ... 158
Fuel used by charcoal furnaces, ... 196
Future iron making in Clarion county not probable, ... 201
Galena, ... 8
Gas, pressure of; in Cherry run test well; in Brundred well, No. 4, . 193,86,163
  in Columbia well, No. 19; in McGrew well, No. 4; in Hope well, 165,167,172
  in James well, ... 149
Gas springs on Catfish run, ... 74
Geological map; color lines on, ... 6,10
Glacial Drift,—in silt; undisturbed position of; none found *in situ*, 18,20,21
  re-worked and re-deposited; pebbles rounded, ... 21
Glacial erosion,—probable agency of, at Fryburg, ... 19,181
Gold, ... 8
Good soil from shaly, loose-grained sandstones, ... 127
Gorge of the Clarion river; of Beaver, Canoe, and Deer creeks, in Beaver township, ... 9,156

Page.

Gravel beds in drift, . . . 18
Greenish sandstone and olive shale associated with red shale, . . . 61
Gray Pocono, (see Upper Pocono in Geological index.)

Hematite,—altered at outcrop from carbonate ore, . . . 185,200
Hematitic ore from Deal's bank, near Shippenville, . . . 199
High Knob, in Salem township, 1600'± above ocean level, . . . 156
High Flats at Lawrenceburg, . . . 20
High Ridge, in Perry township; in Richland township, 1475'-1525' above ocean, . . . 117,152,154
Highest land in Clarion county, near Fryburg, 1750'± above ocean, . . . 180
Homewood sandstone replacing the Clarion sandstone, . . . 145
Horse-shoe bend in the Clarion river at Callensburg, . . . 20

Ice,—probably auxiliary to aqueous erosion, . . . 19
Identification of coal seams difficult when Ferriferous limestone is wanting, . . . 147
Inter-digitation of the Mauch Chunk and Conglomerate measures, . . . 62,63
Interval between the Kittanning Lower coal and Ferriferous limestone small near Callensburg, . . . 126
Iron,—production of charcoal iron in Clarion county, . . . 195
Iron and oil,—effect of on population, . . . 3
Iron ores of Clarion county, . . . 8,197

Kellersburg articlinal,—described; in Madison twp., . . . 24,26,68
  in Porter twp.; in Limestone twp.; in Clarion twp., . . . 87,138,140
  in Mill Creek township, . . . 146

Lawsonham synclinal,—described; in Madison twp., . . . 24,27,68
  in Porter twp.; not well marked in Monroe twp., . . . 87,135
  in Limestone twp.; in Clarion twp.; in Mill Creek twp., . . . 138,140,146
Lead, . . . 8
Licking creek, flowing in the abandoned channel of the Clarion, . . . 125
Lime,—use of on soil discussed, . . . 6
Limestone, (see Freeport upper L.; Freeport lower L.; Johnstown cement L.; Ferriferous L.; Mercer L.; Corniferous L.; Lower Helderberg L.; and Silurian Lower L.; in Geological index.)
Lithological difference between the Pocono and Conglomerate sandstones, 62
Local axes in Clarion county, . . . 65
Long-wall system of mining, . . . 160
Loop in the Allegheny river, below Scrubgrass, probably due to synclinal axis, . . . 29

Martinsburg synclinal axis,—in Beaver township; detected in the oil sand, . . . 29,30,160,188
Mining,—long-wall system of, employed near Edenburg, . . . 160
Millerstown anticlinal,—described,—in Armstrong and Butler counties, . . . 23,24,29
  in Perry twp.; in Licking twp.; in Beaver twp.; in Elk twp., . . . 124 127,157,171
  in Paint twp.; in Farmington twp., . . . 173,183
Millerstown synclinal,—described, . . . 29
Mountain sand,—in Brundred well, No. 4; in Columbia well, No. 19; in Cook well, No. 2, . . . 162,164,184

Page.
Near approach of the Clarion and Kittanning lower coal beds near Strattonville, ... 142
Near approach of the Clarion Upper and Lower coal beds, ... 136,137
Nomenclature,—numerical n. of anticlinals discarded, ... 23
Nonconformability of the Freeport group upon the Kittanning coal beds, ... 91,100
North dip near Reimersburg, ... 84
North dip of axes in Porter township, ... 87

Ocean level datum of elevations, ... 13
Ohio Conglomerate. (See Sharon conglomerate, in Geological index.)
Oil,—in Conglomerate measures at Smith's Ferry and on Slippery Rock creek, ... 64
  in Paint township; production of in Clarion county (tables), 174,190,191
  held in sandrock by capillary attraction; cost of discussed, ... 193
  flow of influenced by pressure from contained gas, ... 193
Oil sand,—physical character of; capacity for containing oil; porosity, . . 187
191,192
Oil territory,—total area (20,560 acres), productive area (7,000); further extension of, discussed, ... 187,190
  development of; effect of on population, ... 5, 3
  area in Perry twp.; in Richland twp.; in Salem twp., ... 119,152,155
  area in Beaver twp.; in Ashland twp.; in Elk twp., ... 156,168,170
Oil well elevations, ... 13,14,15,16
Oil wells,—first in Clarion county; life of wells; size of wells, . . 119,194,193
  in Brady twp.; unsuccessful in Limestone twp., ... 67,138
  in Toby twp.; in Mill Creek twp., ... 85,148,149
Ore in "pots" beneath the Homewood sandstone, ... 117
Ores of copper, silver, gold, lead and zinc, (see ore in Geological index), . 8
Ore-beds in the Conglomerate series at Patton's station, ... 116
Original location of the mouth of Cherry run, ... 125

Parker ancient water channel, ... 17
Peak near Shannondale, ... 9
Pennsylvania geological column, ... 7
Percentage of charcoal obtained from 100 ℔s. of wood (table), ... 196,197
Phosphorous in iron-ores (consult analyses), ... 196
Population, growth of, in Clarion county, ... 2,3
Porosity of oil sand discussed, ... 191,192
Preglacial drainage into Lake Erie, ... 20
Pyrite crystals, ... 8

Railroads of Clarion county, ... 4
Raw coal used in St. Charles furnace, ... 85,94,202
Recent conglomerates in drift, ... 18
Recent flooding of the Allegheny water basin (?) (see prefatory letter), . 19
Red-band in Sligo well record, ... 61
Red-bands characteristic of the Oil sand group and also of the Lower Pocono, ... 179
Red Bank creek,—fall of, ... 17
Red line on Geological map, ... 10
Red Pocono (see Lower Pocono in Geological index).
Ridge containing Kittanning Middle coal in Mill creek twp. ——, . . . 147

Page.
Ridges,—high near Fryburg, ... 9
River silt, ... 18
Roasting of carbonate ores for use in charcoal stacks, ... 199,200

Salt water,—in Sligo well; in James well; none below casing in Brundred well No. 4, ... 134,149,163
 in first oil sand, ... 167
"Salt water" or "40 foot rock,"—in Brundred well No. 4; in Columbia well No. 19, ... 162,164
Sandstone, or sandy measures for 500′ beneath the Ferriferous limestone, 62
Scenery,— picturesque from narrow-guage railroad, ... 154
Scrubgrass coal bed (see Clarion Lower coal in Geological index).
Siderite crystals,—in ball iron-ore, ... 8,140
Silt,—in old valley; glacial drift in; filling Allegheny river valley, 18,18,19
Silver,—ore of, ... 8
Sixth bituminous coal basin (see Brady's Bend synclinal in Geological index).
Slates,—(see Hudson river slates in Geological index).
Soil,—of northern townships cold and clayey; of Conglomerate measures, 5
 south of Clarion river, good, best when limestone is thick; of Kittanning and Clarion groups, ... 5,6
 of Freeport group; warm and fertile from Kittanning and Clarion groups in Red Bank, ... 6,108
 good in Licking twp.; rather poor in Piney twp.; good at Sligo, fair in Monroe twp., ... 125,128,135
 fair to good, some excellent in Limestone twp.; moderately good in Clarion twp., ... 137,140
 good on highland in Mill creek twp.; poor from Congl. measures; good and bad in Richland, ... 146,151,152
 good on highland, poor along streams in Salem twp.; poor in Beaver; fair to good in Ashland, ... 155,157,168
 poor in Elk twp.; very poor in Paint twp.; cold and clayey in Farmington twp., ... 169,173,183
Southeast dip in Porter township, strong, ... 96
Splitting of the Clarion coal into two seams, ... 49
Streams,—classification of the Clarion county water courses, ... 16,17
Streams meeting full in the face, ... 20
Strike of the oil sand,—direction of, ... 188
Sulphide of lead, ... 8
Sulphur in ores,—small, ... 196
Summit of old loop 15′ above water level, ... 21
Summits,—between Red Bank and Clarion river; of northern and southern townships, ... 9
 550′ high in Red Bank twp.; capped by Freeport Lower SS. near Shannondale, ... 98,108
 capped by Freeport Lower sandstone in Monroe twp.; by Kittanning group in Limestone twp., ... 135,138
 along line of Lawsonham synclinal trough in Mill creek twp.; capped by Homewood S. S., ... 146,154
 capped by Kittanning group in northern townships; 1500′—1575′ above ocean in Ashland twp., ... 151,168
Surface erosion, ... 20

Page
Surface of Clarion county,—character of the, ... 9
Surface rocks of Clarion county, ... 6
Swampy ground in old channel opposite Parker, ... 18

Terebratulæ in Ferriferous limestone, ... 158
Terraces,—from old ore workings,—in Porter twp. at St. Charles furnace, 73,96
made by the escarpment of the Homewood sandstone, ... 169
Terracing of hillsides by the Kittanning coal beds and Ferriferous limestone, ... 108
Thinning away of the Freeport Lower sandstone (local), ... 100
Timber,—used by charcoal stacks; in northern townships; nearly exhausted in Farmington twp., ... 6,152,184
Topography,—of Clarion county; coloring on map an index to, ... 9,10
Townships of Clarion county, ... 2
Tunnel through neck of Long Bend, ... 5
Tunnel through neck of Brady's Bend, ... 67

Umbral (see Mauch Chunck red shale in Geological index).
between layers of the Conglomerate, ... 63
Union of the Clarion Upper and Lower coal beds, ... 49,50,51,55,137
Unit of erosion, ... 20
Utilization of slack coal by coking, ... 101

Ventilation,—defective in mine near Strattonville, ... 143
Vespertine sandstone (see Pocono in Geological index).

Washing slack,—analyses showing effect of, ... 102
West dip in Porter township, ... 96

Zigzag course of the Clarion river caused by Brady's Bend anticlinal, . . 146
Zinc,—ore of, ... 8

III. Index to the Geological Formations.

Upper Productive coal measures, ... 7
Barren measures,—extent of; color on map, ... 6,7, 10
Mahoning sandstone, and described; in Madison twp., ... 31, 77
caps high summits in Porter twp., ... 89, 94
Millerstown coal-bed,—at Miller's Eddy, thin, ... 123

Lower Productive Coal Measures.

Area of in Clarion county; color on map; described, ... 6,7,10,31-56
Freeport group, described; soil of; area in Perry twp., ... 33,6,117
Kittanning group,—soil of; group described; area in Perry twp., . . 6,41,117
area in Clarion twp.; contains no workable coal beds at St. Petersburg, ... 140,154
Clarion group,—described; area in Clarion twp.; in Knox twp., . 49,140,176

Freeport Upper Coal.

Described; outcrop incorrectly shown on contoured map, ... 34, 67
Used raw in St. Charles charcoal furnace, ... 35,94,202
In Toby twp,, 4′ thick and variable, 30′ of cover; good in Madison twp., 4′ thick, analysis of coke, ... 78,68, 70

Page.

At Goheen's bank 4' 9'' thick (analysis); at St. Charles furnace 3' 9'' thick, used raw, ... 89, 94
Not worked at Fairmount, cover too thin; at Wilhelm's bank 4' 2'' thick, 99,107
Two miles south of West Freedom, good, ... 122

Freeport Upper Limestone.

Described in Clarion county, ... 36
At New Athens exposed on road (analysis), ... 74
In Toby twp. 4' thick six feet under Freeport Upper coal; quarried in hill near West Freedom (analysis), ... 79,122

Freeport Upper Ore.

Described; dug in highland near West Freedom; 2' thick at Miller's Eddy, ... 37,197,122,123

Freeport Upper Sandstone.

Described, generalized section of associate rocks, ... 37

Freeport Lower Coal.

Described,—analysis of, ... 37,38, 39
In Brady twp. thin and slaty; in Madison twp. thin, ... 67, 68
In Toby twp. good (analysis), 3' 9'' thick; 45' below upper bed at Goheens, 6' 6'' thick and good, ... 79,80,90
At Lowrie's bank, 4' thick; at McNutt's opening 9' thick (analysis), . 90, 92
In Porter twp. mistaken for upper bed; 400' above the railroad at McKinley's bank, ... 91, 92
At Wilkins' bank 8' thick and good (analysis); 264 acres on Sligo furnace lands, ... 93
At Ditty's, in Porter twp., 5' 8'' thick; thin and poor in southwestern portion of Porter twp., ... 94, 97
At Fairmount 200' above the railroad, 5' 6''—7 0', thick and good (analyses), ... 100,101
Coke made from slack coal at Fairmount (analyses), ... 102
Not found in Monroe twp.; coke used in St. Charles furnace, ... 135,202

Freeport Lower Limestone.

Described; resembles upper bed, but is more earthy and ferruginous, . . 40
Two miles N. E. of Reimersburg, 2'-3' thick, 190 feet above Ferriferous limestone (analysis), ... 80
"Flag-lime" in Porter twp., opening near Brinkerton; not now exposed at Fairmount, ... 97,103
On Pine run, at Mr. Clinger's place, 190' above stream, poor quality; at Truitt's is 10' below coal, ... 111,113

Freeport Lower Sandstone.

Described; caps summits in S. W. part of Porter twp., ... 40,97
Hard and massive near New Athens; soft and shaly in summits of Monroe twp., ... 74,135
At Fryburg forms the cap-rock, ... 181

Page.

Kittanning Upper Coal.

Described,—in Brady twp., thin; in Madison twp., thin, ... 41,67, 68
At New Athens; at Bowersox's bank, 2'-3' thick; at Fairmount 2' thick, cannel at New Bethlehem, ... 74,91,103
At Huffman's 13''-14'' thick, not seen at Shannondale; thin in Perry twp.; 1' 6 ' thick at Miller's Eddy, ... 107-109,121,123
Not seen in Monroe twp.; at Fryburg, not exposed, ... 135,181

Johnstown Cement Limestone.

Described,—a calcareous iron-ore in Clarion and Butler counties, . . . 43, 64
At Fairmount 2'-3' (?) thick, 100 feet below the Freeport Lower coal (analysis), ... 103-104

Kittanning Middle Coal.

Described; table of analyses, ... 44, 45
In Brady twp., not thick; in Madison twp., thin, ... 67, 68
At Somerville's bank, in Toby twp., 50' below Kitt. Upper bed, and 3' 8'' thick (analysis); at Henry Courson's bank, 1' 6'', ... 81,85
Near Brinkerton 75' above the Ferriferous, thin; at Fairmount, good, 1' 6''-2' 0'' thick (analysis), ... 96,104
At Shannondale 50' above the Kitt. Lower coal; thin in Perry twp., . 109,121
In Monroe twp. 2' 6'' thick, not worked; not seen in Clarion twp., . . 135,143
In Mill Creek twp.; not exposed at Edenburg, ... 147,158
At Fryburg 4'-5' thick, but quite slaty, ... 181

Kittanning Lower Coal.

Described,—table of analyses,—analyses of coke, ... 45,46,48
250' above railroad level; in Brady twp., 230' above railroad, ... 24, 66
In Madison twp. good; 3' thick; 30' above Ferriferous limestone, . 68,71, 72
At Ramsey's bank, 3' thick, pyritous; at Catfish 48' above limestone, 4' 6'', sulphurous, ... 73-74,75-76
In Toby twp., at Reigle's, 3' 6'' thick; at Sligo Coal Co. banks, 3' 6'' (analysis,) 82, 83
At Courson's bank 2' 11'', 30' above limestone, ... 85
In Porter twp., 25' above limestone, at Brinkerton 2' 9''-3' 0'' good coal, . . 96
At St. Charles furnace 2' thick, 35' above limestone; at Will's bank 3' thick, good, ... 97
At Fairmount 4' 11' thick (analysis); at Huffman's 2' 6'', ... 105,108
At McKillip's bank 3' thick and good; at Shannondale 2' 2''-3' 4'', good, 108,109
At Songer's mine 3' 0''-3' 4'', good (analysis); at Reinzel's bank 3' thick and good, ... 110,111
At Truitt's 3' 0''-3' 9'' and good, 30' above limestone, ... 112
In Perry twp., at West Freedom, 2' 7''-2' 10'', good (analysis;) at Miller's Eddy, 3 6'', ... 120-121,123
Near Upper Hillville, 3' 10'', pyritous, ... 124
In Licking township, near Callensburg, 10' above limestone, 2' 3''-2' 7'' thick, ... 127
At Sligo, banks fallen shut, (analysis; at Fox bank 3' 1''-4' 2'' and good, (analysis), ... 131
In Monroe twp., on Keifer estate, 3' thick, with a bad slate parting, . . . 136

Page.

In Limestone twp., 3′ 6″ thick and good near Greenville; at Mechanicsville lies close to Ferriferous limestone, 2 6″ thick, ... 139
At Stewart's bank 3′ 6″ thick, roof poor, ... 140
In Clarion twp., at Fleming's bank near Corsica, 2′ thick, good, 40′ above limestone, ... 141
At Young's bank 2′ 11″ thick; mined at shaft of Clarion Coal Co. (analysis), ... 143,144
In Mill Creek twp., 2′ 6″–3′ 0″ thick, but not mined, ... 147
In Salem twp. has very little cover; in Ashland twp. is soft, thin and impure, ... 155,168
At Helen Furnace 3′ 6″–4′ 0″ thick and good, with 10′–35′ of cover, . . 175–176
At Lucinda Furnace 2′ thick, cover thin, not mined; at Fryburg 20′ above limestone, 2′ 6″ thick and good, ... 177,181
In Farmington twp. hills not high enough to catch it, ... 185

Limestone Ore—(sometimes called "Buhrstone Ore.")

Description and analyses of, ... 52–54,178–179,197–199
In Brady twp, 6″–10″ thick; in Madison twp. largely worked 10″–24″ thick, ... 66,69–70
On Wildcat run 9″–12″ thick; thin in Red Bank twp.; thin in Perry twp., ... 73,110,117
In Licking twp. 6″–15″ thick; in Piney twp. good at Sligo, large workings, (analysis), ... 125,128–129
On Fox farm thick and good (analyses); at Madison furnace, ... 133
In Monroe twp. large workings, thick (14″); near Corsica in Clarion twp. (analysis), ... 136,141
In northern townships large areas worked out; in Beaver twp., . . . 151,157
In Ashland twp. thin; at Deals' bank near Shippenville 4′–6′ thick! (analysis), ... 168,170
At Helen furnace 12′–18′ below Kitt. Lower coal, 6″–24″ thick, ... 176
At Lucinda furnace large workings, 6″–24″ thick, character described; in "pots" at Fryburg, ... 178–179,182

Ferriferous Limestone.

Described; absence of over large areas; analyses, ... 52,53,54
Outcrop of; outcrop not horizontal, sometimes wanting; in isolated hill top, ... 6,10,18
Used as a flux by charcoal furnaces, ... 200
At water level in Fairmount synclinal; 350′ above railroad level at Patton's station, ... 24,25
In Brady twp. 15′ thick, easily accessible; in Madison twp. large area of, 66,68
At Lawsonham 220′ above railroad level; on Wildcat run 6′–8′ thick, makes good lime, ... 70,82
On Cherry run 65′ above Homewood SS.; in Potter twp. accessible along all large streams, ... 84–85,87
At New Bethlehem 5′–6′ thick with a little ore on top; on Long run, pure. (analysis), ... 95
At Fairmount at water level; 50′ above Homewood SS. 2 miles south of Shannondale 4′–7′ thick, ... 106,110

Page.

At Perryville 12'-16' thick; near West Freedom 20' thick; at Miller's Eddy 8'-10' thick, ... 119,122,123
On Catfish run (analyses); in Licking twp. 10' thick 10' below Kitt. Lower coal, ... 124,126
At Callensburg, outcrop far back from river, ... 127
In Piney twp. 130' above water level at Sligo, outcrop marked by old ore diggings, ... 128
In Limestone twp. quarries frequent; in Monroe twp., several quarries not now worked, ... 137,136
In Clarion township, absent over large areas; at Hindman's quarry (analysis), ... 140,141
In Mill Creek twp. absent; in Paint twp. absent, ... 146-147,173
In northern townships; finely situated for quarrying at Heaters cross-roads, ... 151,152
In Richland twp., 4'-7' thick; sometimes wanting, ... 152,153
In Salem twp. area small; in Beaver twp. 110' of cover near Edenburg, 6'-7' thick, ... 155,156-158
Absent 1½ miles southeast of Edenburg, ... 159
In Ashland twp. in summits, 6'-6" thick, ... 168
In Elk twp. rarely seen north of Shippenville, often absent, ... 169
At Helen Furnace in two knobs, 5'-7' thick; at Lucinda Furnace 4'-5' thick, ... 175,177
At Fryburg 5'-6' thick, quarries in slabs; at Scotch Hills 4'-5' thick, in three round tops, ... 182,185

Clarion Upper (Scrubgrass) Coal.

Described,—coalesces with Clarion Lower coal; at Edenburg 1' thick; at West Freedom 2' thick; at Disler's, in Venango county, 1' 6' thick, . . 55
In Perry twp., at Switzer bank, 10' below limestone, 3' 1" thick, ... 120
In Monroe twp., at Williamsburg, 5' above Clarion Lower coal, 2' 6" thick, variable, ... 136,137
In Richland twp. thin, 8' below limestone; in Salem twp. close to limestone, thin, ... 153,155
At Edenburg 7' below limestone 1' thick, good; at Delo bank 2' 5" thick, ... 158-159,160
In Ashland twp. thin; near Shippenville 15' below limestone 2' 6"-3' 0" thick, ... 168,170

Clarion Lower Coal.

Lower bench of Clarion coal; described, ... 49, 55
In Toby township 2'-2' 6" thick, not mined; in Porter twp. Cannel coal 4' thick near New Bethlehem, ... 85, 94
At Shannondale, opened and abandoned; at Truitt's 1' 8" thick, good smithing coal, ... 110,112
In Midland test oil well, ... 115
In Perry twp. close to Ferr. limestone at Putney bank, 3' 7" thick, . . . 119
At West Freedom 4' thick, sulphurous; at Williamsburg 1' thick and 5' below upper bench, ... 122,137
One mile east of Clarion 1' 6" thick; at Clarion 3' thick, but poor, . . 144,145

Page.

Between Emlenton and St. Petetsburg 3′ thick and pyritous, 30′ below limestone, ... 153
In Salem twp. 2′ 6″–3′ 0″ thick, rather slaty and sulphurous, ... 155
At Edenburg 1′ 5″–1′ 7″ thick, 10′ below upper bench; 1½ miles S. E. of Edenburg 1′ 9″ thick, ... 159
In Ashland twp. thin; in Paint twp. thin and slaty, ... 168,173
At Lucinda 3′ 9″–4′ 0″ thick, sulphurous; at Fryburg mined by stripping 2′ 2″ thick, ... 177,182
Near Tylersburg (possibly Brookville bed) 2′ 3″–2′ 9″ thick and sulphurous; at Scotch Hills, 3′, sulphurous, ... 184,185

Clarion Sandstone.

Hard and massive 15′–20′ thick; sometimes replaced by Homewood sandstone, ... 145
In Mill Creek twp.; hard and massive near Monroeville, ... 147,161
In Highland twp. 35′ thick; in Knox twp. poorly developed, ... 176,178

Brookville Coal.

Described,—absent by displacement, wanting, ... 51,55, 56
In Licking twp., one mile from Easton, 2′ 8″ thick, fair quality, ... 126
In Piney twp., at Beer's bank, 2′ 6″–3′ 0″ thick; in Monroe twp. poor, not worked, ... 130,137
Near Corsica, 4′ thick, exposed by stripping; at shaft of Jas. Wilson, Strattonville, ... 142,144
One mile south of Clarion, 3′ thick; in Mill Creek twp. at Stallman's, 4′ thick, poor, ... 145,148
At Miller's bank 2′ 3″–2′ 7″ thick, fair quality; mined near Monroeville for oil well use, ... 147–148,161
At Edenburg 28′ below Clarion Lower coal, 2′ thick; 1½ miles S. E. of Edenburg, thin and poor, ... 159,160
In Salem twp. thin and slaty; in Ashland twp. thin (2′), ... 156,168
In Elk twp. thin, lies a few feet above Homewood SS.; in Paint twp. thin and slaty, ... 169,174
In Highland twp. 2′ 6″–3′ 0″ thick and poor; at Lucinda 55′ below . . . . . Clarion coal, 1′–1′ 6″ thick, ... 176,178
Near Lickingville 3′ 0″ thick, pyritous; one mile N. of Scotch Hills, 3′ thick, cover thin, ... 182,185

Conglomerate Series, No. XII.

Soil of poor; area; color on map; base of, ... 5,6,7,10
Good exposures even in bluff hillsides rare; exposed along railroad, . . 17,24
Above water level along the Brookville anticlinal, ... 25
Described,—in contact with Pocono S. S.; downward extension uncertain, ... 59–60,60,60–62
In anthracite coal fields; coal thin and poor, best under Homewood sandstone, ... 63
In Madison twp. well exposed at Red Bank; in Licking twp. shaly and loose-grained, ... 69,127
Area in Mill creek twp.; in Paint twp.; in Farmington twp., . . 146,173,183

Page.

Homewood Sandstone.

In old valley at Parker; absent in Columbia well No. 19, ... 18,60
In Madison twp. bluffs; in Toby twp. above water level on Cherry run, 72,84
In Porter twp. 50′-65′ below Ferr. limestone on Long run; massive conglomerate 15′-30′ at Rockville, ... 95,96
In Red Bank twp. exposed along Pine run; in Perry twp. 28′ thick at Miller's Eddy, ... 108-109,123
In Limestone twp. hard and massive on Piney creek; in Salem twp. bluffs, ... 138,155
In Ashland twp. hard and massive, ... 169

Mercer Group.

Horizon of in Clarion county; in Midland oil well, ... 24,113

Mercer Coal Beds.

Beneath Homewood sandstone, good on Catfish run; in Madison twp., 63,72,75
In Toby twp. on Cherry run; In Perry twp. at Miller's Eddy, . . . 84,123
In Limestone twp. valueless; in Paint twp. thin and slaty, . . . 138,173-174
At North Pine grove (?) 2′-3′ thick and good, ... 185

Mercer Ore Beds.

Stratigraphical equivalents of the Mercer limestone (?), ... 63,64
In Perry township mined at Black Fox furnace; analyses of in Butler county, ... 117,118
In Licking twp.; mined in Beaver twp. bog ore mined near Shippenville, ... 127,160,170-173

Connoquenessing Sandstone.

Horizon of group; hard and massive on Clarion river, ... 24,137
Sharon conglomerate, overlies Mauch Chunk red shale, ... 58
Sub-carboniferous rocks, described, ... 57-64

Mauch Chunk Red Shale No. XI. (*Umbral.*)

Place in series; color on map, near water level; at railroad level at Patton's station, ... 7,10,25
Not red in western Clarion county, ... 57
Described in wells at Brookville, Snydersburg, Marienville, Sligo and Edenburg, ... 58
In Brundred well No. 4; in Beaver Falls well, ... 58
Present at Sharon in Mercer county as soft ferruginous shales; in Hunt and Towler well, ... 60,61-62
In Red Bank twp. at Patton's station; in Snydersburg well; wanting in Cook well record, ... 116,179-180,184

Pocono Sandstone, No. X. (*Vespertine*).

Place in series; color on map, thickness above water level, ... 7,10
Described in Clinton, Cameron, Lycoming and Elk counties, ... 57,58
Upper and Lower Pocono described, ... 57-58
In contact with the Conglomerate measures, ... 60

Page.

Third Mountain Sand (Berea Grip).

Part of Upper Pocono; in Toby twp. in wells, ... 85

Oil Sand Group, (Lower or Red Pocono).

Described,—equivalent of red Pocono of the east, ... 58,188-189
First sand,—In Toby twp.; in Brundred well No. 4, ... 85,163
  In Columbia well No. 19; in McGrew well No. 4, ... 165,166
"*Big Red*" *Rock*,—In Brundred, Columbia, and McGrew wells, . 163,165,167
  characteristic of Clarion oil sand group, ... 188
Third Sand,—in Brundred, Columbia, and McGrew wells, . . . 163,165,167
  in Hope well, ... 172
  described,—dip of sand, ... 187,188
Fourth Sand, in Toby twp.; in McGrew well, No. 4, ... 86,167
Red Catskill, No. IX, absent in Clarion county (?), ... 7
Chemung, ... 7
Portage, ... } *VIII*, { 7
Hamilton, ... 7
Corniferous limestone,—depth beneath surface, ... 7
Oriskany sandstone, No. VII, ... 7
Lower Helderburg limestone, No. VI, ... 7
Clinton group, No. V, in Eastern Pennsylvania, ... 7, 61
Medina SS., ... } *IV*, { 7
Oneida conglomerate, ... 7
Hudson River slates, No. III, ... 7
Lower Silurian limestone, No. II,—depth beneath coal measures, . . . 7, 8
Potsdam sandstone, No. I, ... 7
Eozoic Rocks, ... 19

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.

REPORTS FOR 1874, 1875, 1876, 1877, 1878, AND 1879.

The following Reports are issued for the State by the Board of Commissioners, at Harrisburg, and the prices have been fixed as follows, in accordance with the terms of the act:

PRICES OF REPORTS.

A. Historical Sketch of Geological Explorations in Pennsylvania and other States. By J. P. Lesley. With appendix, containing Annual Reports for 1874 and 1875; pp. 226, 8vo. Price in paper, $0 25; postage, $0 06. Price in cloth, $0 50; postage, $0 10.

B. Preliminary Report of the Mineralogy of Pennsylvania—1874. By Dr. F. A. Genth. With appendix on the hydro-carbon compounds, by Samuel P. Sadtler. 8vo., pp. 206, with *map* of the State for reference to counties. Price in paper, $0 50; postage, $0 08. Price in cloth, $0 75; postage, $0 10.

B.^{2} Preliminary Report of the Mineralogy of Pennsylvania for 1875. By Dr. F. A. Genth. Price in paper, $0 05; postage, $0 02.

C. Report of Progress on York and Adams Counties—1874. By Persifor Frazer, Jr. 8vo., pp. 198, illustrated by 8 *maps* and *sections* and other illustrations. Price in paper, $0 85; postage, $0 10. Price in cloth, $1 10; postage, $0 12.

CC. Report of Progress in the Counties of York, Adams, Cumberland, and Franklin—1875. Illustrated by *maps* and *cross-sections*, showing the Magnetic and Micaceous Ore Belt near the western edge of the Mesozoic Sandstone and the two Azoic systems constituting the mass of the South Mountains, with a preliminary discussion on the Dillsburg Ore Bed and catalogue of specimens collected in 1875. By Persifor Frazer, Jr. Price, $1 25; postage, $0 12.

D. Report of Progress in the Brown Hematite Ore Ranges of Lehigh County—1874, with descriptions of mines lying between Emaus, Alburtis, and Foglesville. By Frederick Prime, Jr. 8vo., pp. 73, with a contour-line *map* and 8 *cuts*. Price in paper, $0 50; postage, $0 04. Price in cloth, $0 75; postage, $0 06.

DD. THE BROWN HEMATITE DEPOSITS OF THE SILURO-CAMBRIAN LIMESTONES OF LEHIGH COUNTY, lying between Shimersville, Millerstown, Schencksville, Ballietsville, and the Lehigh river—1875-6. By Frederick Prime, Jr. 8 vo., pp. 99, with 5 *map-sheets* and 5 *plates*. Price, $1 60; postage, $0 12.

E. SPECIAL REPORT ON THE TRAP DYKES AND AZOIC ROCKS of Southeastern Pennsylvania, 1875; Part I, Historical Introduction. By T. Sterry Hunt. 8 vo., pp. 253. Price, $0 48; postage, $0 12.

F. REPORT OF PROGRESS IN THE JUNIATA DISTRICT on Fossil Iron Ore Beds of Middle Pennsylvania. By John H. Dewees. With a report of the AUGHWICK VALLEY AND EAST BROAD TOP DISTRICT. By C. A. Ashburner. 1874-8. Illustrated with 7 *Geological maps* and 19 *sections*. 8 vo., pp. 305. Price, $2 55; postage, $0 20.

G. REPORT OF PROGRESS IN BRADFORD AND TIOGA COUNTIES—1874-8. I. LIMITS OF THE CATSKILL AND CHEMUNG FORMATION. By Andrew Sherwood. II. Description of the BARCLAY, BLOSSBURG, FALL BROOK, ARNOT, ANTRIM, AND GAINES COAL FIELDS, and at the FORKS OF PINE CREEK IN POTTER COUNTY. By Franklin Platt. III. ON THE COKING OF BITUMINOUS COAL. By John Fulton. Illustrated with 2 colored *Geological* county *maps*, 3 *plates* and 35 *cuts*. 8 vo., pp. 271. Price, $1 00; postage $0 12.

H. REPORT OF PROGRESS IN THE CLEARFIELD AND JEFFERSON DISTRICT OF THE BITUMINOUS COAL FIELDS of Western Pennsylvania—1874. By Franklin Platt. 8vo., pp. 296, illustrated by 139 *cuts*, 8 *maps*, and 2 *sections*. Price in paper, $1 50; postage, $0 13. Price in cloth, $1 75; postage, $0 15.

HH. REPORT OF PROGRESS IN THE CAMBRIA AND SOMERSET DISTRICT OF THE BITUMINOUS COAL FIELDS of Western Pennsylvania—1875. By F. and W. G. Platt. Pp. 194, illustrated with 84 *wood-cuts* and 4 *maps* and *sections*. Part I. Cambria. Price, $1 00; postage, $0 12.

HHH. REPORT OF PROGRESS IN THE CAMBRIA AND SOMERSET DISTRICT OF THE BITUMINOUS COAL FIELDS of Western Pennsylvania—1876. By F. and W. G. Platt. Pp. 348, illustrated by 110 *wood-cuts* and 6 *maps* and *sections*. Part II. Somerset. Price, $0 85; postage, $0 18.

HHHH. REPORT OF PROGRESS IN INDIANA COUNTY—1877. By W. G. Platt. Pp. 316. With a colored map of the county. Price, $0 80; postage, $0 14.

I. REPORT OF PROGRESS IN THE VENANGO COUNTY DISTRICT—1874. By John F. Carll. With observations on the Geology around Warren, by F. A. Randall; and Notes on the Comparative Geology of North-eastern Ohio and Northwestern Pennsylvania, and Western New York, by J. P. Lesley. 8 vo., pp. 127, with 2 *maps*, a long *section*, and 7 *cuts* in the text. Price in paper, $0 60; postage, $0 05. Price in cloth, $0 85; postage, $0 08.

II. REPORT OF PROGRESS, OIL WELL RECORDS, AND LEVELS—1876-7. By John F. Carll. Pp. 398. Published in advance of Report of Progress, III. Price, $0 60; postage, $0 18.

J. SPECIAL REPORT ON THE PETROLEUM OF PENNSYLVANIA—1874, its Production, Transportation, Manufacture, and Statistics. By Henry E. Wrigley. To which are added a Map and Profile of a line of levels through Butler, Armstrong, and Clarion Counties, by D. Jones Lucas: and also a Map and Profile of a line of levels along Slippery Rock Creek, by J. P. Lesley. 8 vo., pp. 122; 5 *maps* and *sections*, a *plate* and 5 *cuts*. Price in paper, $0 75; postage, $0 06. Price in cloth, $1 00; postage, $0 08.

K. REPORT ON GREENE AND WASHINGTON COUNTIES—1875, Bituminous Coal Fields. By J. J. Stevenson, 8 vo., pp. 420, illustrated by 3 *sections* and 2 county *maps*, showing the depth of the Pittsburg and Waynesburg coal bed, beneath the surface at numerous points. Price in paper, $0 65; postage, $0 16. Price in cloth, $0 90; postage, $0 18.

KK. REPORT OF PROGRESS IN THE FAYETTE AND WESTMORELAND DISTRICT OF THE BITUMINOUS COAL FIELDS OF WESTERN PENNSYLVANIA—1876. By J. J. Stevenson; pp. 437, illustrated by 50 *wood-cuts* and 3 county *maps*, colored. Part I. Eastern Allegheny County, and Fayette and Westmoreland Counties, west from Chestnut Ridge. Price, $1 40; postage, $0 20.

KKK. REPORT OF PROGRESS IN THE FAYETTE AND WESTMORELAND DISTRICT OF THE BITUMINOUS COAL FIELDS of Western Pennsylvania—1877. By J. J. Stevenson. Pp. 331. Part II. The LIGONIER VALLEY. Illustrated with 107 *wood-cuts*, 2 *plates*, and 2 county *maps*, colored. Price, $1 40; postage, $0 16.

L. 1875—SPECIAL REPORT ON THE COKE MANUFACTURE OF THE YOUGHIOGHENY RIVER VALLEY IN FAYETTE AND WESTMORELAND COUNTIES, with Geological Notes of the Coal and Iron Ore Beds, from Surveys, by Charles A. Young; by Franklin Platt. To which are appended: I. A Report on Methods of Coking, by John Fulton. II. A Report on the use of Natural Gas in the Iron Manufacture, by John B. Pearse, Franklin Platt, and Professor Sadtler. Pp. 252. Price, $1 00; postage, $0 12.

M. REPORT OF PROGRESS IN THE LABORATORY OF THE SURVEY AT HARRISBURG—1874-5, by Andrew S. McCreath. 8 vo., pp. 105. Price in paper, $0 50: postage, $0 05. Price in cloth, $0 75; postage, $0 08.

MM. SECOND REPORT OF PROGRESS IN THE LABORATORY OF THE SURVEY at Harrisburg, by Andrew S. McCreath—1876-8, including I. Classification of Coals, by Persifor Frazer, Jr. II. Firebrick Tests, by Franklin Platt. III. Notes on Dolomitic Limestones, by J. P. Lesley. IV. Utilization of Anthracite Slack, by Franklin Platt. V. Determination of Carbon in Iron or Steel, by A. S. McCreath. With 3 indexes, plate, and 4 page plates. Pp. 438. Price in cloth, $0 65; postage, $0 18.

N. REPORT OF PROGRESS—1875-6-7. Two hundred Tables of Elevation above tide level of the Railroad Stations, Summits and Tunnels; Canal Locks and Dams, River Riffles, &c., in and around Pennsylvania; with *map;* pp. 279. By Charles Allen. Price, $0 70; postage, $0 15.

O. CATALOGUE OF THE GEOLOGICAL MUSUEM—1874-5-6-7. By Charles E. Hall. Part I. Collection of Rock Specimens. Nos. 1 to 4,264. Pp. 217. Price, $0 40; postage, $0 10.

P. 1879—ATLAS OF THE COAL FLORA OF PENNSYLVANIA AND OF THE CARBONIFEROUS FORMATION THROUGHOUT THE UNITED STATES. 87 plates with explanations. By Leo Lesquereux. Price, $3 35; postage, $0 22.

Q. REPORT OF PROGRESS IN THE BEAVER RIVER DISTRICT OF THE BITUMINOUS COAL FIELDS OF WESTERN PENNSYLVANIA. By I. C. White; pp. 337, illustrated with 3 *Geological maps* of parts of Beaver, Butler, and Allegheny Counties, and 21 *plates of vertical sections*—1875. Price, $1 40; postage, $0 20.

QQ. REPORT OF PROGRESS IN 1877. The Geology of Lawrence County, to which is appended a Special Report on the CORRELATION OF THE COAL MEASURES in Western Pennsylvania and Eastern Ohio. 8 vo., pp. 336, with a *colored Geological Map* of the county, and 134 vertical *sections*. By I. C. White. Price, $0 70; postage, $0 15.

V. REPORT OF PROGRESS—1878. Part I. The Northern Townships of Butler county. Part II. A special survey made in 1875, along the Beaver and Shenango rivers, in Beaver, Lawrence and Mercer Counties. 8 vo., pp. 248, with 4 *maps*, 1 profile *section* and 154 vertical *sections*. By H. Martyn Chance. Price, $0 70; postage, $0 15.

Other Reports of the Survey are in the hands of the printer, and will soon be published.

The sale of copies is conducted according to Section 10 of the Act, which reads as follows:

* * * "Copies of the Reports, with all maps and supplements, shall be donated to all public libraries, universities, and colleges in the State, *and shall be furnished at cost of publication to all other applicants for them.*"

Mr. F. W. FORMAN is authorized to conduct the sale of reports; and letters and orders concerning sales should be addressed to him, at 223 Market street, Harrisburg. Address general communications to WM. A. INGHAM, Secretary.

By order of the Board,
WM. A. INGHAM,
Secretary of Board.

Rooms of Commission and Museum:
223 Market Street, Harrisburg.

Address of Secretary:
223 Market Street, Harrisburg.

UNIVERSITY OF MICHIGAN
3 9015 03582 6014